SCIENTIFIC AMERICAN

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THE MANUFACTURE OF WIRE GLASS AT TACONY, PHILADELPHIA, PA.

The subject of protecting glazed skylights is one which of late years has acquired additional importance. The construction of large railroad depots illustrates the tendency of the day. In such structures as the Grand Central Depot in this city, light is given to the interior by large skylights. These are placed in the roof of the building and are of very large area. At a height of nearly a hundred feet above the floor they are a constant menace to life. The glass used in their construction is necessarily of considerable thickness. If it breaks and falls, the heavy sharp-edged pieces are perfectly capable of inflicting a fatal blow. If a piece were to fall upon a car roof it would very probably cut its way through, and embed itself in the bottom of the car if it did not go through that also. The force of the blow of course depends on the size of the piece. Some extraordinary accounts have been given of the penetrative power of glass which has actually fallen from such a skylight.

To prevent accidents of this kind a copper wire network is often stretched over the framework of the skylight directly under the glass, or in some equivalent position, with a view of catching any pieces which may be detached or broken loose. This is a partial solution of the difficulty only. The wire gauze is liable to corrode, or its fastenings may become loosened, so that it may be quite useless. Corrosion is especially to be feared in railroad stations and train sheds. The gases from the locomotive smokestacks is a source of corrosion, as the sulphurous fumes attack both copper and iron. In such situations also it is found that large sheets of glass tend to crack.

We illustrate an experimental plant for the production of wire glass, a substance designed to overcome these difficulties. The product consists of rolled glass, with iron wire netting embedded in its own substance. Thus the wire is hermetically inclosed, and is secure from corrosion for any length of time. The machine and process is the invention of Mr. Frank Shumann, of Philadelphia, Pa. At the works illustrated in our cut, as much as ten tons of the material was produced. The glass made under the conditions incident to experimental appliances was so perfect, and of such obvious merit, that it obtained the fullest appreciation from the architects and engineers of the country. Work is now in active progress on extensive plant and buildings for the production of the new material in commercial quantities.

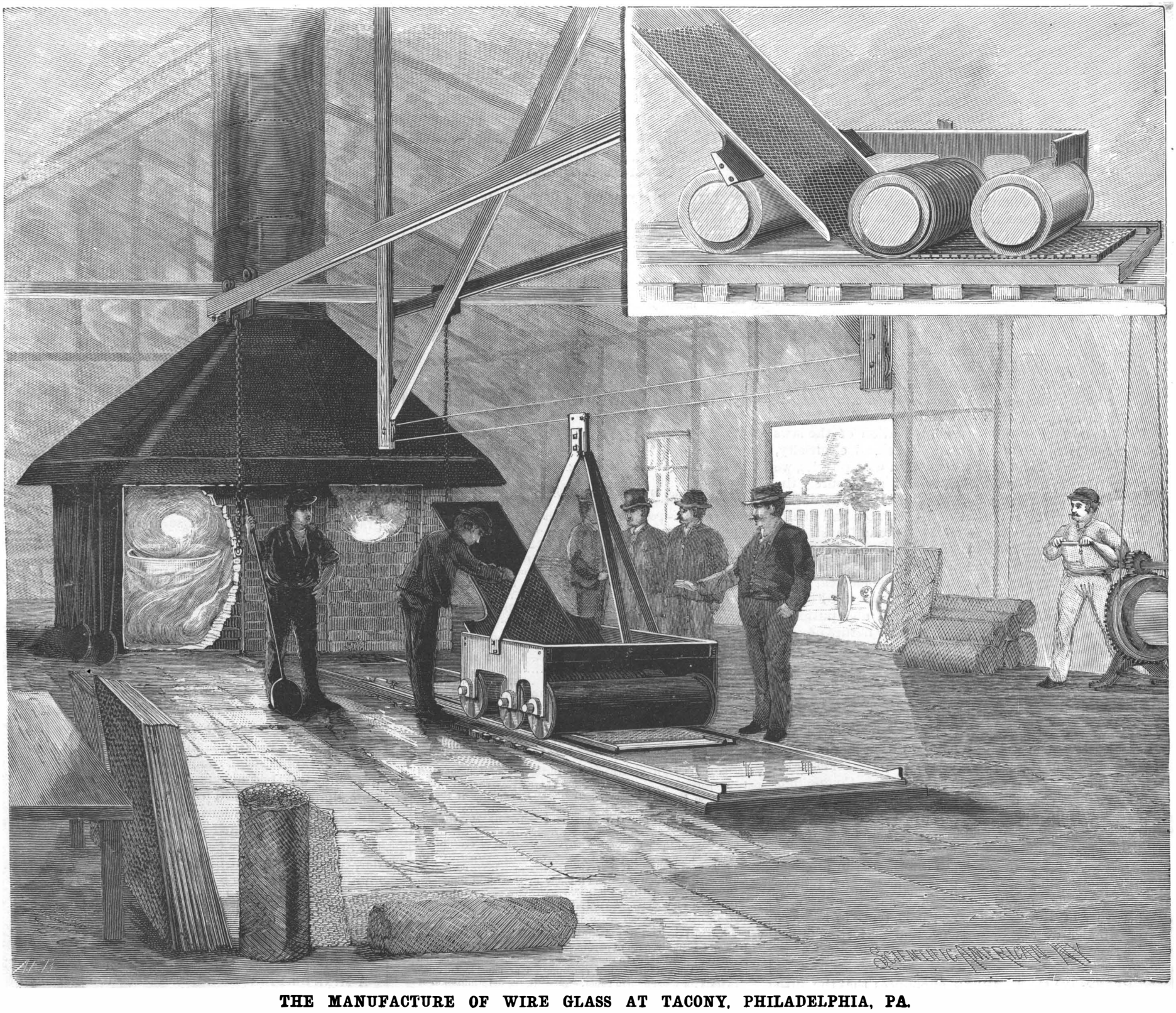
The general principle of operation is as follows:

A glass rolling table with side ledges is provided. A three-roller carriage moves over it, running on the side ledges. The glass is rolled out upon this table, the ledges regulating its thickness. Two of the rollers are smooth; the central roller has a series of grooves running around it. Between the leading roller and the corrugated roller a slide is placed for the reception of a sheet of wire gauze. Arrangements are provided for traversing the rollers from end to end of the table.

The rollers are hollow, and, in the experimental plant, red hot iron cores are introduced in them to heat them.

The glass has been melted in an adjacent furnace. The sheet of wire gauze is heated, and all is ready for the rolling. A proper quantity of melted glass is poured out upon the table, the hot sheet of wire gauze is placed in its carrier, and the roller carriage is started. As the carriage progresses a little, the wire is dropped. The first roller has rolled out the glass. The wire gauze strikes the partly fluid glass, and is drawn under the corrugated roller. This seizes it, and by its corrugations forces it into the pasty glass to the required depth. The compound mass then goes under the third roller, where it is rolled smooth, and the operation is completed. The sheet is now annealed in the usual way, and is ready for use.

By modifications in the apparatus various products may be obtained. The wire gauze may be heated so hot as to receive a corrugated contour, which it retains in the glass. It may on the other hand be worked at



THE MANUFACTURE OF WIRE GLASS AT TACONY, PHILADELPHIA, PA.

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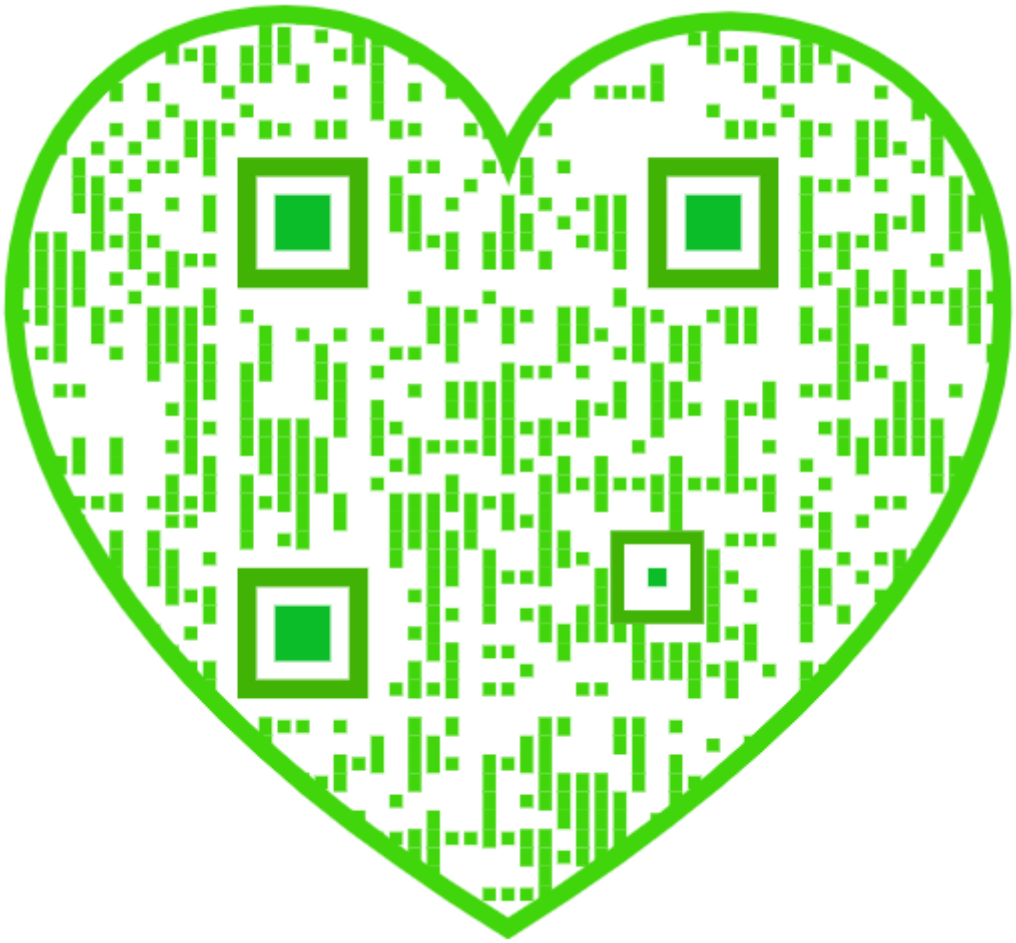

so low a temperature as to lie quite flat in the finished product. The corrugated roller may be adjusted to give it any desired depth in the glass.

Sheets of wire glass six feet long, two feet wide and three-eighths of an inch thick have been rolled at the experimental plant in thirty-five seconds.

The American Wire Glass Co., of Tacony, Philadelphia, Pa., has been formed to exploit this invention. By the beginning of next year they expect to have in active operation their factory already alluded to, with a daily capacity of about 5,000 square feet of wire glass. The most improved appliances are to be used, so as to render the operations as nearly automatic as possible. Gas fuel will be used and the rollers will be heated by the same.

The new product has other uses than those mentioned. It is to some extent burglar proof. It is not known what is the heaviest wire which can be used, but it is obvious that glass several inches thick with one or two sheets of heavy steel wire gauze embedded in its center would be very resistent to any attacks by burglars. For pavement lights it is also applicable, as it has great weight-sustaining power. A heavy man can walk and jump on one of the sheets made in the experimental works. Last not least is its power of resisting projectiles. It can be made so that a pistol ball will not penetrate it, thus affording a material for windows and other lights which will be secure from all ordinary missiles.

Science in Medicine.

The recent address at St. George's, London, was delivered by Dr. Bowles, of Folkestone. The lecturer commenced by welcoming the new students, and urging them all to preserve the tradition that "a St. George's man is expected at all times and under all circumstances to be a gentleman." The apprenticeship system was announced to be dead—defeated by the rapid march of science. This led to the main subject of the address, "the application of physics to physic." It was pointed out that all changes occurring in physiological and pathological processes, formerly supposed to depend on that unknown quantity, "vital force," were really nothing more than the action of the recognized forces of nature on the organs and structures of the body. Coughing, sneezing, snoring, etc., were all shown to have immediate origin in physical conditions. Surgery is the proper application of the laws of physics; injured parts and broken limbs are kept at rest, dislocated parts are placed in their natural positions, redundancies are removed, and natural deficiencies often well supplied; crooked paths are made straight, and blocked and narrowed ones made patent; stiffened joints are made to move, crooked limbs put into shape, eyes are made to see that would not, and ears to hear that could not.

Surgery is a department of physics—a physical art. Medicine, formerly the region of the unknown and the happy hunting ground of quacks, is rapidly following in the same lines. The so-called practical man and the believer in dogmas and nostrums are rapidly giving way to minds trained in the laws of physics. Physiology, Medicine's forerunner and its handmaid, is steadily, step by step, and without prejudice, elucidating the ways and doings of animal life. By instruments of the most elaborate and delicate nature, by patient and continuous observation, by anatomical and histological searchings, and by the application of the laws of gravitation, chemistry, heat, light and electricity, always by ways and means connected with physics, we are getting to understand better and more surely the movements and functions of respiration, of circulation and digestion, of secretion and excretion, and finally we hope to understand the most subtile and mysterious of all functions—the operation of the nervous system.

The lecturer then reviewed the rapid progress made in late years in the studies on which the medical art is based. Schroeder in Germany and Pasteur in France, by their investigations on fermentation and putrefaction, and Chauveau on the particular nature of contagia, have opened up an entirely new world. We have now not only to study the causes as well as the changes of the disease in the body, but also the doings of the bacteria outside the body and within it. In view of the more scientific methods of modern pharmacology and therapeutics, students were cautioned against long and complicated prescriptions. Not a single drug ought to enter the body except under clear intention of what object it is to fulfill there. Compounds may be good cookery, but do not form scientific medicine. Finally, students were warned against mistaken views of materialism. The students of the physical and biological sciences are emphatically the servants of nature. The man of science interprets the physical laws, and equally with the teacher of religion tells us of the greatness and grandeur of the Creator. Every discovery of the scientist can only tend to increase our wonder at the omniscience and perfection of the ways of God.

PROFESSOR C. A. YOUNG announces that the fifth satellite of Jupiter has been seen by his assistant, Mr. Reed, with the 23 inch equatorial, at Princeton.

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Contents.

(Illustrated articles are marked with an asterisk.)

Boiler room mistakes..... 292
Books and publications, new.... 299
Bridge, Brooklyn, railway, capacity..... 288
Car heating, steam..... 297
Celluloid negatives, varnish for. 291
Cheese..... 289
Corner shelf, Legg's*..... 292
Cotton picker, Hyde's*..... 291
Fair, the, after dedication..... 289
Glass, wire, manufacture of*.... 287
Gooseberry rats..... 294
Gun trials, interesting..... 294
Heron hunting*..... 294
India rubber, artificial..... 296
Inventions, recently patented... 298
Kerite..... 294
Launch, steam, the fastest..... 298
Magnets, great, experiments with..... 293
Mechanical improvements recent..... 298
Medicine, science in..... 288
Medicine, scientific research in.. 293
Natural history notes..... 296
Notes and queries..... 299
Paint, Lender's..... 296
Paper making, something about. 292
Patents granted, weekly record of..... 299
Photographic developer,amidol.. 289
Photographing vowel sounds.... 288
Photography at the fair..... 288
Railway station, Philadelphia*.. 291
Sea sickness..... 298
Steamera, lake..... 291
Steamer, Atlantic, Graham's*... 295
Stereoscopic prints, transferring* 297
Telephone, New York-Chicago*. 295
Thinking, the art of..... 292
Trees, ornamental, removing.... 293
Tripe..... 292
Waterworks, Plainfield, N. J.*.. 290
Wire glass, manufacture of*..... 287

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 879.

For the Week Ending November 5, 1892.

Price 10 cents. For sale by all newsdealers.

PAGE

I. ELECTRICAL.—Portable Accumulators for Stage Effects.—3 engravings 14044

II. ENGINEERING.--Aberration Problems.—A lecture on "The Motion of the Ether near the Earth."—By Dr. OLIVER LODGE, at the Royal Institution.—10 engravings.—An interesting article..... 14051
Compound Express Engine.—Paris, Lyons, and Meditteranean Railway.—3 engravings..... 14039
Roberval's Method of Drawing Tangents.—By Professor C. W. MACCORD, Sc.D.—A full article.—11 engravings..... 14042

III. HORTICULTURE.—The Tall Flowers of Autumn..... 14047

IV. MEDICAL AND SURGICAL.- Vertigo.—A paper read before the Medical Society of Virginia..... 14048
Removing the Vermiform Appendix. 14048
Salophen.—A new remedy for rheumatism..... 14053

V. METALLURGY.—The Cohesive Property of Gold—Its Character, Value, and Availability.—By S. H. GUILFORD, D.D.S, Ph.D, Philadelphia, Pa.—A paper read before the joint union meeting of the Pennsylvania and New Jersey State Dental Societies..... 14044

VI. MISCELLANEOUS.—Genoa—The Birthplace of Columbus.—1 large engraving..... 14047
Crypt of the Royal Chapel, Granada.—1 engraving of the sepulchers of Ferdinand and Isabella..... 14047
The Future of the Gutta-percha Supply.—By M. EUGENE SERULLAS..... 14048
The Days of the Week of any Given Date.—For 60 centuries.—A valuable paper..... 14049
Training of Horses.—11 engravings..... 14050
The Determination of Carbon Dioxide in the Air of Buildings.—By AUGUSTUS H. GILL, Ph.D..... 14053
Peroxide of Sodium.—An interesting article.—By M. PRUD'HOMME..... 14054

VII. TECHNOLOGY.—Paper Testing.—An exhaustive article, giving tests of tensile strength of papers.—Calculation of the "breaking strength."—Resistance to rumpling and rubbing.—Mineral residue of papers, ash.—Microscopical examination of papers.—Qualitative tests for wood pulp in paper.—Quantitative determination of ground wood in paper.—Determination of the kind of sizing.—Determination of the amount of sizing..... 14039
Frame for Singeing Cotton Thread.—2 engravings..... 14041

NEW YORK AND BROOKLYN BRIDGE CABLE RAILWAY OPERATIONS DURING THE WEEK OF THE COLUMBUS FESTIVAL.

Never was the bridge so crowded with people as during the gala days of the Columbian anniversary. Commencing on Sunday, October 9, 453 trains were dispatched, 392 of which had a headway of from 3 to 2 minutes.

On Monday 549 trains were dispatched, 120 of which had but 1½ minutes' headway. Tuesday, 558 trains, 212 at 1½ minutes' headway. Wednesday, the rush day, 697 trains were dispatched, of which 346 were on 1½ minutes' headway. The number of passengers carried was, on Sunday 99,309, Monday 188,677, Tuesday 158,085, and on Wednesday 223,625, gradually falling off to the normal number at the end of the week. The whole number for the week was 1,091,539. The greatest rush was from Wednesday, 8:15 A. M., until Thursday, 8:15 A. M., 24 hours' continuous run of the cars carrying 258,593 passengers.

The speed of the cable is 10⅓ miles per hour; it is 1½ inches diameter, and 12,000 feet long. It wears out in about 15 months, having a haulage service of about 20,000,000 ton miles. The greatest recorded work of the cable engines is 1,093 horse power. Cars weigh from 17 to 19 tons, and there are 60 in service, 48 running during rush hours. The above enumeration only includes railway passengers riding by ticket. The immense throng by the foot and roadway can only be estimated, and probably reached the number of 200,000 or more, making the total travel over the bridge on Wednesday, October 12, nearly half a million people. Not the slightest accident is known to have occurred. When we consider that one-half of the immense train service of Wednesday was run on 1½ minutes' headway, without a break, we cannot but accord the highest praise to its management.

PHOTOGRAPHY AT THE WORLD'S FAIR.

When the question of granting photographers the right to photograph, for a small fee, at the World's Fair grounds was submitted to the Ways and Means Committee last spring, it was announced that no such privilege would be permitted, as it would interfere with the parties who might secure the sole right to photograph, from whom large payments were expected.

As soon as this announcement was made, a movement was inaugurated by the editor of the *American Amateur Photographer* to obtain the sentiments of the various photographic clubs and societies on the proposition to exclude the camera of the amateur photographer, which resulted in nearly every organization disapproving the idea and urging the authorities, through special petitions, to reconsider their decision, on the ground that more money would be raised by admitting the camera at a small fee than could be derived by restricting the privilege to a few at a higher charge.

We are gratified to be able to state that the desires of the amateur photographers have been substantially acceded to. It was officially announced on the 25th of October by the official photographer of the World's Columbian Exposition, Mr. C. D. Arnold, that on and after that date "Hand cameras using plates up to and including 4 × 5 inches, without tripods, will be allowed within the grounds of the World's Columbian Exposition, on payment of a fee of two dollars in addition to the regular price of admission for each day. Cameras using stereoscopic lenses will not be admitted, however small the plate may be."

This decision practically opens the grounds to photographers and will enable those desiring to secure photographs for themselves from their own point of view to do so. It is we think very creditable to the World's Fair authorities that they have decided to grant some concessions to the amateur photographers, and will undoubtedly be the means of greatly increasing the amount of free advertising the fair will get, while the manufacturers and dealers in photographic materials will also greatly profit by the increased demand for their goods.

Photographing the Sound of Vowels.

At the recent International Congress of Physiology at Liege, Professor Hermann demonstrated his method of photographing the sound of vowels. The vowels were sung out before one of Edison's phonographs. Immediately afterward they were reproduced very slowly, and the vibrations recorded by a microphone. The latter was furnished with a mirror, which reflected the light of an electric lamp upon a registering cylinder, covered with sensitized paper and protected by another cylinder with a small opening which gave passage to the rays of light from the reflector. By this means was obtained very distinct photographic traces, and the constancy was remarkable for the different letters.

A MINE ON FIRE SINCE 1858.—The burning mine at Summit Hill, near Mauch Chunk, Pa., has been on fire since 1858.

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The World's Fair after the Dedication.

After the great success which attended the dedicatory exercises at Chicago, a lull in the work of the fair seems to have ensued. This, however, is but an appearance. After the celebration was over, and after the troops from all parts of the country had returned or were *en route* to their respective homes, the public attention has been directed to other channels. But the impressiveness of the recent ceremonies grows as they are thought over. The great building, with the thousands of spectators, the band and chorus, the presence of so many eminent civilians, army and navy representatives, members of diplomatic corps, and the like, was a worthy step in the way of progress of the great work. After the interruption caused by the proceedings the operations are again actively under way. The prospect is that America will produce not only an unequaled exposition of arts and industries, but that it will be conceived and executed in a period of time unequaled in brevity for such an affair.

The location of the site for the buildings is a very recent event. Even the chosen city was an object of speculation until within a few months, and already the city of the lakes has shown that her enterprise and energy are more than a matter of reputation. The buildings are nearly complete. Probably the greatest assemblage of spectators ever gathered under similar conditions under one roof were witnesses of the progress already made. They found many of the great structures practically ready for occupancy. The participants and spectators in general saw a great part of a veritable city of industry rising from the plain.

The buildings harmonized well with the mass of humanity surrounding them. The route of the military procession, as it wound through the grounds, was overshadowed by the buildings. These formed a fitting background for the military parade. The water and bridges and other features of the grounds added to the picturesque effect.

Another element of interest was incident to the occasion. For the first time the grounds and buildings appeared with their proper concomitants of a great assemblage. The effect of the structures is not to be judged of as they stand isolated and untenanted. But when the isolation is destroyed by surrounding crowds, and when their interiors are filled with an immense concourse of people, some judgment can be reached as to what the final effect will be. In this aspect the celebration possessed peculiar interest. The suitability of the edifices for human occupancy was tested. Their adaptability and power of harmonizing with a mass of humanity seemed perfect. The sense of desolation that the enormous empty structures have hitherto inspired was done away with. The hum of life gave a new and, as yet, unseen aspect to the scene; for, until the celebration, so great an audience had never tenanted the great hall, and so many people had not yet visited the grounds in one day.

We have alluded to the scope of the celebration. The exposition commemorates an event in the world's history. It is no national or municipal event that has called forth the fair. America felt that her turn had come in the family of nations to hold an exposition. The lapse of four hundred years has produced the anniversary it celebrates. Unequaled in this feature, it is to be hoped that all will progress to a favorable issue. That such will be the case it is hard to doubt. So much has been done that the future is secure. The fair will be in fact as in its origin a celebration worthy of its historical anniversary.

Amidol—a New Photographic Developer.

When, in the fall of 1889, we found that eikonogen was what may be termed a universal developer, working equally as well in the development of negatives and positives either on plates or paper, we were certain that further improvements would be made, as the introduction of hydroquinone and eikonogen opened a new field in developing agents. Previous to that time the ferrous oxalate and pyro developers were used almost exclusively. Last year the para-amidophenol developer was introduced, and was accelerated in its action by the use of a caustic alkali or a carbonate, particularly carbonate of potash.

The claims for these improved developers were that they possessed unusual oxidizing power on the gelatine bromide film, but would not, even in prolonged development, cause it to stain.

The newest chemical of the same class is called "amidol," which is a diamidophenol. It has lately been introduced into this country, and possesses unusual characteristics as a photographic developer. It is supplied in minute grayish white crystals, resembling those of hydroquinone. It is almost as soluble in cold water as pyro, and requires no other accelerator to produce developing action than the sodium sulphite, so long used as a preservative in other developers. A plain solution of amidol dissolved in distilled water tests acid with blue litmus paper. By itself, poured on a plate having had a time exposure, after five minutes' action no image is discernible; but by adding a solution of sodium sulphite until there is an equivalent of three grains of sulphite to one of amidol, development at once gradually begins and continues steadily until the negative is completed. The solution made in these proportions also tested slightly acid. These facts were ascertained after several experiments.

It is advisable to use only rain, melted ice water or distilled water, as water containing a lime or a similar alkali produces a turbidity and a precipitate. The strength of the solution recommended by the manufacturers is, in our opinion, too great for convenient working, and instead of mixing the amidol and sulphite in one solution we prefer to mix the amidol fresh each time it is desired to develop a batch of plates. The following method may be recommended: First, prepare a stock solution of neutral sodium sulphite:

Sodium sulphite	100 grs.
Water	1 oz.

To make a two ounce developer, dissolve eight grains of amidol in one and three-quarter ounces of water, then add two drachms and a half of the sodium sulphite solution, pour this combined solution on the plate. If no action is observed after a minute's time add half a drachm more of the stock solution; continue these additions *ad libitum* until the developer works up to the rapidity desired. By operating gradually in this way, an overtimed plate may be developed perfectly without the addition of a bromide.

Amidol dissolved in distilled water changes from a colorless solution in three hours to a dark clear ruby red. The sulphite acts as a preserver and as an accelerator. A solution having 100 grains of sulphite to 10 grains of amidol in distilled water changes in an open graduate exposed to the air from a colorless solution to a deep orange in a week's time. In either case the sulphite keeps the solution clear.

The formula recommended by the makers is:

Amidol	80 grs.
Sodium sulphite	800 "
Water	8 oz.

To form the developer the above is diluted from three to four times and a few drops of bromide may be added if desired to check development.

Taking two ounces of the above strong solution, we added thereto in a graduate six ounces of water, which gave a solution of amidol equivalent to about three grains to the ounce. With this eight ounces we developed perfectly in a few minutes ten 10 x 12 bromide prints.

The rapidity of this developer, as well as its absolute freedom from stain, are its remarkable features, and bring it up to an equal with the iron developer used in the wet plate process. It acts as rapidly on a shutter-exposed plate as one having a time exposure, and builds up the density with equal rapidity, thereby producing easily brilliant negatives. For all kinds of plates or bromide paper it appears to be the most simple and perfect developer yet devised. For lantern slides it is admirable, giving high lights in clearness equal to the wet plate, while the density is regulated by the amount of amidol in the developer.

We developed a shutter-exposed plate in less than two minutes to full density where usually it takes ten. It will be seen also that no alkali is required, in fact an alkali added to a plain solution of amidol, after being on a plate for five minutes, produces no result except to oxidize the solution and turn it quickly to a deep ruby red. The new developer is one of the best improvements that has been made.

Cheese.

Experiments have been made at the New York Agricultural Experimental Station in conjunction with the New York State Dairy Commission.

The details of these experiments are given in the Bulletin No. 43, published at the Geneva Station, N. Y., from which we cull the following summary:

Fat.—The amount of fat lost in the whey increased in some cases and decreased in others, when the amount of fat in the milk increased.

The average amount of fat lost in the whey in all the experiments was 0·29 pounds (about 4½ ounces) for 100 pounds of milk, which was about 7·5 per cent of the fat in the milk. In the factory experiments, the average loss of fat was about 9 per cent of the fat in the milk; while, in the station experiments, the average loss was about 7 per cent of the fat in the milk.

Casein and Albumen.—The amount of casein and albumen lost in the whey increased quite uniformly when the casein and albumen in the milk increased.

The average amount of casein and albumen lost in the whey in all the experiments was 0·74 pound (about 12 ounces) for 100 pounds of milk, averaging 0·64 pound in the factory and 0·81 pound in the station experiments. From 23·5 to 24 per cent of the casein and albumen in the milk was lost, the proportion of loss being quite uniform in all the experiments.

Of the 0·74 pound (or 12 ounces) of casein and albumen lost, 0·15 pound (about 2½ ounces) consisted of casein and 0·59 pound (about 9½ ounces) of albumen. About 6 per cent of the casein and 82 per cent of the albumen in the milk was lost, on an average.

In the various lots of milk used there were, on an average, 2·4 pounds of casein and 0·72 pound of albumen, or for every pound of albumen there were about 3·3 pounds of casein.

The proportion of fat in the cheese increased, as a rule, when the amount of fat in the milk increased, but the increase of fat in the cheese was not uniform with the increase of fat in the milk. Green cheese, made from factory milk that contained about 3 pounds of fat in 100 pounds of milk, contained about 33 pounds of fat in 100 pounds of cream. Cheese made from whole milk, to which cream had been added, and which contained 6 pounds of fat in one hundred pounds of milk, contained 42 pounds of fat in 100 pounds of cheese. Cheese made from milk containing about 3·35 pounds of fat in 100 pounds of milk contained about 35 pounds of fat in 100 pounds of cheese. When the milk contained about 4·25 pounds of fat in 100 pounds of milk, the cheese contained from 36 to 36·5 pounds of fat in 100 pounds of cheese. In case of milk, partially skimmed, containing 3·56 pounds of fat in 100 pounds of milk, the cheese contained nearly 32 pounds of fat in 100 pounds of cheese.

Basing a comparison of results upon the water-free cheese, instead of green cheese, we obtain results that are quite similar in their relations.

In general, the fat exercised a greater influence upon the composition of the cheese than any other constituent of the milk.

In the cheese made from the normal milks, the amount of casein and albumen in one hundred pounds of cheese was a fairly uniform quantity, varying in the green cheese from 22 to 24 pounds and in the water-free cheese varying from 36 to 38 pounds. The milks containing least fat made cheese containing a little more casein and albumen. Skimming the milk partially increased largely the amount of casein and albumen in the cheese, while adding cream to whole milk diminished the amount of casein and albumen in the cheese.

The results appear to indicate that in cheese made form normal milk containing from 3 to 4·25 pounds of fat in one hundred pounds of milk, there should be about 1·4 pounds to 1·5 of fat for one pound of casein and albumen in the water-free cheese. Partial skimming reduced this ratio to 1·22 pounds, while addition of cream raised it to over 2 pounds.

Of the increased yield of cheese obtained in the various experiments, nearly one-half of the increase, on an average, was due to an increase of fat in the milk from which the cheese was made.

The amount of fat retained in the cheese made from one hundred pounds of milk increased when the amount of fat in the milk increased, but not with exact uniformity.

On an average, the increase of casein and albumen in the milk produced a little over one-fifth of the increased yield of cheese observed in the various experiments.

The amount of casein and albumen retained in the cheese made from one hundred pounds of milk increased quite uniformly when the amount of casein and albumen in the milk increased.

Water.—About one-third of the increased yield of cheese was due to an increased amount of water retained in the cheese.

The amount of water retained in the cheese made from one hundred pounds of milk was quite variable, and increased when either the fat or casein and albumen in the milk increased.

Pounds of Cheese Made from Milk.—Of the factory milk, there were required, on an average, 11·4 pounds to make one pound of cheese.

Of the station milk, 8·8 pounds sufficed to make one pound of cheese.

The low yield of cheese from the factory milk was mainly due to the small amount of fat, casein, and albumen contained in it, that is, to the poor quality of the milk; and, in addition, the loss in manufacture was a little greater. The poor quality of the milk was probably due to the fact that the cows were in the earlier stage of their period of lactation.

Variation in Amount of Rennet Used.—In two sets of comparisons, only one case showed any difference in loss of fat, casein, and albumen, and this was when the amount of rennet used was much less than the usual amount. No difference of yield was shown that could be attributed to variation in the amount of rennet used.

Cutting Curd in Hard and Soft Condition.—In two sets of comparisons, one case of soft cutting gave a little larger loss of fat and casein. In one case the soft cut curd gave a little larger yield, owing mainly to the retention of more moisture.

The loss of weight varied, for the first month, from 5·5 to 8·87 pounds, and averaged 6·95 pounds for each hundred pounds of green cheese.

ORDINARY grated horse-radish, eaten at frequent intervals during the day and in connection with food at the table, if food is eaten at all, has been found remarkably efficacious in banishing the distressing cough that frequently lingers after all the other symptoms of the grip have gone. It can do no harm to try it, at all events.

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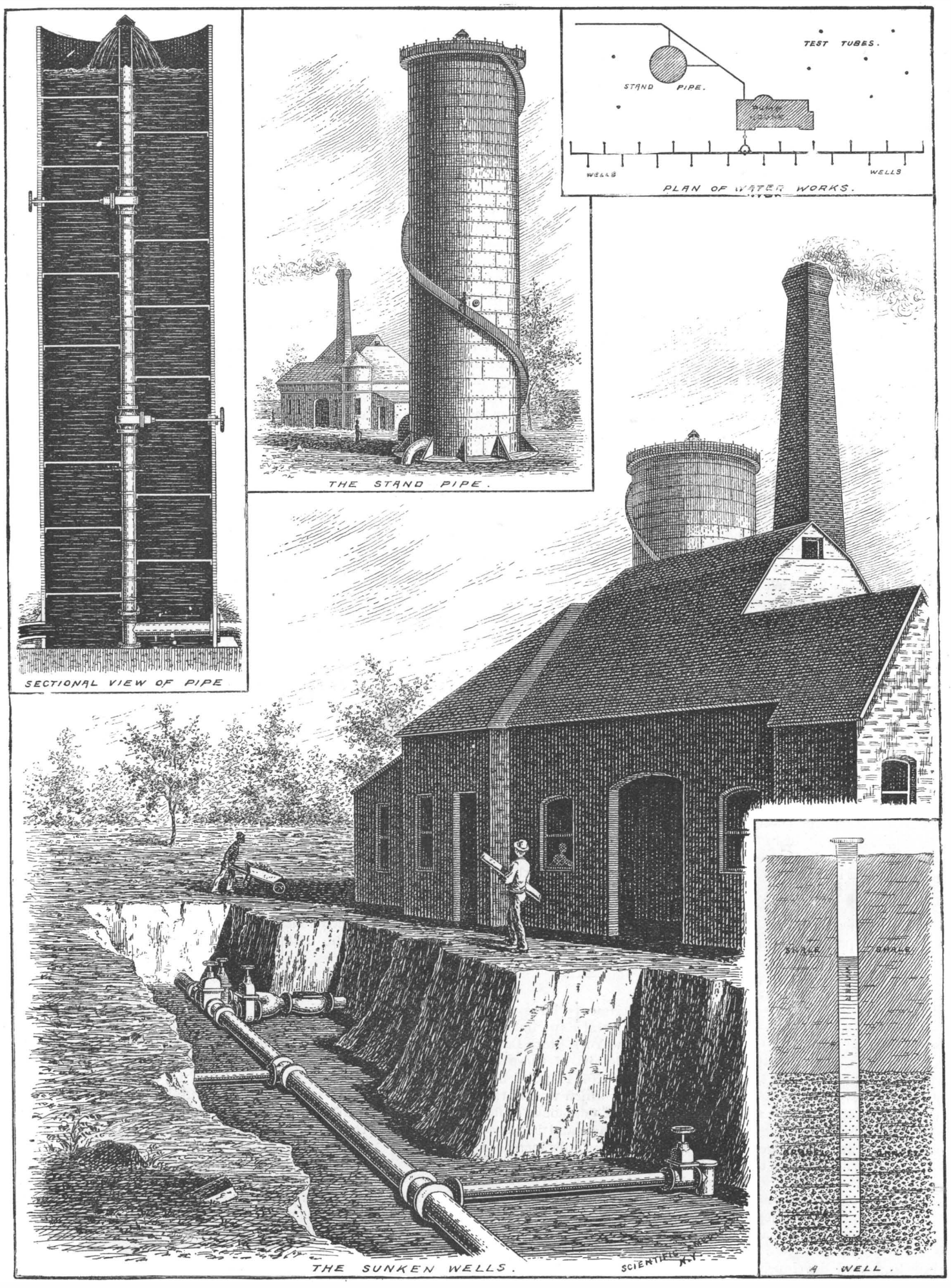
PLAINFIELD, N. J., WATER WORKS.

An underground river, with the clearest and purest of water, has been discovered near the city of Plainfield, N. J. A few months ago the water company began to drive wells, and, after going over about five square miles of country and striking inferior qualities of water, they struck pure water at Netherwood Station, on a line with the Central Railroad, two miles this side of the city, at the depth of fifty feet. Here they sunk a number of wells, and then made a test. After pumping seven days and nights, drawing out of the earth 2,000,000 gallons of pure water every twenty-four hours, and their test tubes showing no decided fall, it was concluded that they had an inexhaustible supply. Twenty six-inch wells were then sunk to the depth of 50 ft., the wells being about 50 ft. apart and sunk in a zigzag manner for a distance of 1,000 ft. Running between these wells is a pipe, which is attached to the end wells. This pipe is 6 in. at the ends, increasing in size as it runs toward the center up to 12 in., changing in size about every 125 ft. Each section of pipe rests on two saddles, the saddles fitting over the top of a post 5 ft. in length, which rests on a foundation of lumber 3 ft. square. The wells are about 8 ft. from this pipe on each side and connected to it by a 6 in. pipe. At the center of the 12 in. pipe are three large valves which turn the water on or off from the pumping station, a small valve being also attached to each well. Each well has at its bottom a 12 ft. strainer. The earth through which these wells are driven is a hard shale, running down to a depth of 27 ft. It is so compact that no drainage or surface water can get through it, and below it is a bed of sand and gravel, through which the pure and clear water flows. The wells run down to the depth of 20 ft. into this bed, the gravel in which is smooth and polished, showing that the water is constantly moving. The natural force of this underground river brings the water up to within 18 ft. of the surface. Two Worthington compound condensing pumps with 18 in. stroke are used for drawing water from the wells and forcing it up into the stand pipe. The pumping capacity of these pumps is 5,000,000 gallons every 24 hours, and the pumps are run with 80 lb. pressure of steam. The stand pipe is 25 ft. in diameter and 140 ft. in height, and is made of wrought iron plates of four different sizes ¾, ⅝, ½, and ⅜ in., in twenty-eight tiers and double bolted. The water is forced up through a 20 in. pipe, running up the center of stand pipe, to a height of 144 ft., the water flowing over the top and falling down into the stand pipe. This 20 in. pipe is securely braced to the sides of stand pipe with angle iron braces bolted to the sides, and has two valves, one at 50 ft. and the other at 100 ft. from the ground, which can be opened and closed from the outside of stand pipe. The foundation for the stand pipe is 10 ft. in depth and 33 ft. in diameter, and is made of cracked stone and cement, 10 ft. bolts, 2 in. in diameter, securely fastening the stand pipe to the foundation. This pipe holds 515,000 gallons, and has a pressure at the bottom of 62½ lb. There is a fall of 25 ft. from the station to the city of Plainfield. There are twenty seven miles of pipe laid in the city. Water is also furnished to the city of Elizabeth, N. J., to the extent of 1,500,000 gallons daily. The water analysis is: Total solid, 8·86; chlorine, 0·44; free ammonia, 0·001; albumenoid, 0·0058; and the temperature of the water as it comes from the wells is 52 degrees.

The cost of the water works is about $450,000.



NEW WATER WORKS AT PLAINFIELD, N. J.

A NEW material, called rubber velvet, is made by sprinkling powdered felt of any color over rubber cloth while the latter is hot and soft; the result looks like felt cloth, but is elastic, waterproof and exceedingly light.

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Lake Steamers.

The Owego is the fastest steamer on the lakes, having made the run from Buffalo to Chicago, 889 miles, in 54 hours and 15 minutes—16·4 miles per hour. With her sister ship, the Chemung, she has the finest coefficient of displacement of any steamer on the lakes, and on her regular runs develops more power than any other lake vessel. At 80 revolutions and with 160 pounds of steam the Owego's engines, the largest on the lakes, developed 2,606 horse power. Her engines are 28, 42½, and 72 by 54 inches stroke. Smaller steamers make 12 and 14 miles an hour with from 1,200 to 1,400 horse power and carry almost twice as much. This is only an example showing the great amount of power required to add a mile to the normal speed.—*Marine Review.*

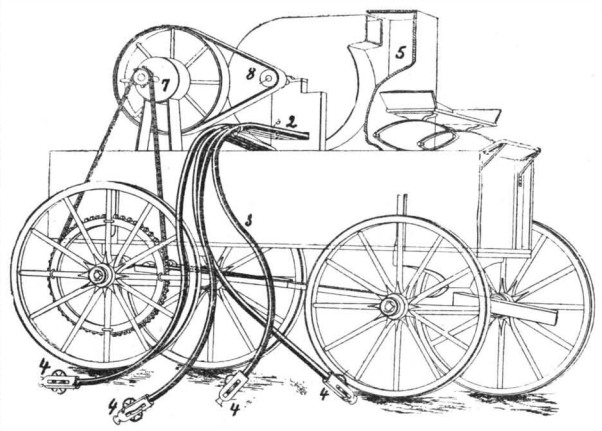
NEW BROAD STREET STATION AT PHILADELPHIA.

We show in this issue a perspective view, reproduced from the architect's drawing, of the new passenger station of the Pennsylvania railroad at Broad Street, Philadelphia. The drawing explains itself and little description is necessary. It will be observed that the existing station, which appears at the extreme right of the cut, will remain of the same height as at present. The most novel feature of the completed building will be the arcade, extending over a portion of the sidewalk throughout the entire front and a part of the sides. At the extreme left of this arcade is a platform extending out to the curb line. This platform is on the track level and affords a convenient means of transferring baggage from the station to wagons without lifting it. The currents of arriving and departing passengers are entirely separated, the main exit being on the Market Street side. The east front has a large number of entrances. The principal entrance for the offices in the upper stories will be at the main entrance, corner of Broad and Market, and at the corner of Fifteenth and Filbert. Definite plans for the upper floors have not yet been made, but it is estimated that there will be about 200 offices, so as to accommodate all the officers and clerks now housed at Fourth and Walnut Streets.

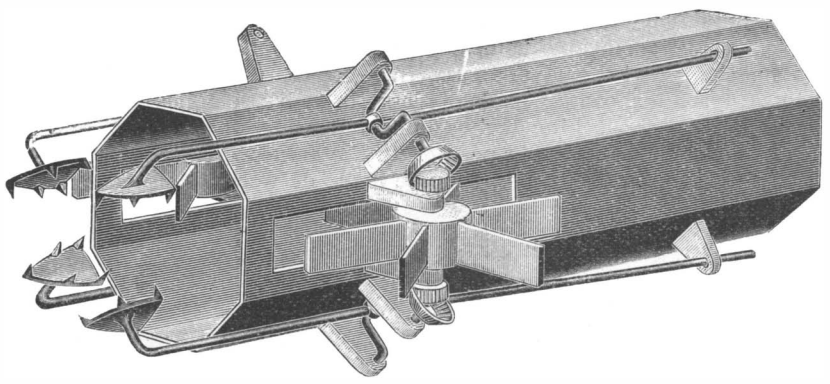
The train shed is 307 feet by 707 feet, and will be 140 feet high at the center. The main arches have a clear span of 294 feet and a clear height of 104½ feet. The structure will require 3,000 tons of iron, and there will be about 1¾ acres of glass in the roof. The officers of the road, who have made careful comparisons, state that this train shed will be the largest in the world, larger even than those of the Midland, the London, Chatham & Dover, and others in London.—*Railroad Gazette.*

AN IMPROVED COTTON PICKER.

The cotton picking machine shown in the illustration is of simple and inexpensive construction, as compared with many other devices which have been brought forward for facilitating the gathering of the cotton crop, and is designed in its operation to simulate the action of the hand as nearly as possible. The improvement has been patented by Mr. Thomas B. Hyde, of Taylor, Texas. The apparatus is mounted in a wagon to be drawn over the field, a fan case, 1, being connected with tubular conveyers, 2, having flexible extensions, 3, at the ends of which are the "pickers," 4, the mechanism of which is shown in one of the views. The power to operate the fan is preferably obtained by belting from one of the wheels of the vehicle to a spring motor, 7, the latter being connected by another belt with the fan shaft, 8, the cotton being drawn up through the flexible tubes, by the suction thus made, to a suitable receptacle, 5, whence it may also be delivered into the wagon, 6. An electric or other motor may be employed, if desired, in which power may be stored to operate the fan while the wagon is at a standstill long enough to permit the picking of all the cotton within reach. It is designed that four or more of the pickers shall be connected with the tubular conveyers on each side, each operator holding in each hand a picker, which is held successively to the different heads of the cotton plants in reach. The picker is inclosed in a shell having a handle to be grasped by the operator, a sleeve in this shell having a slot in each side, in which work oppositely arranged fans. The shafts of these fans carry pinions, which operate cranks attached to reciprocating arms on the sides of the sleeve, the front ends of these arms being bent inwardly and terminating in claws or fingers. The small fan wheels in the pickers are rotated by the suction caused in the conveyers as the main fan is revolved, and a rapid reciprocating motion is thus communicated to the picker arms, the toothed jaws of which detach the cotton from the boll and throw it back, the wings of the small fan wheels aiding in taking the cotton from the picker jaws, and the suction carrying the picked cotton through the flexible tubes to the receiver. The inventor of this machine has lived in the cotton country all his life, and the improvement is the result of much experimenting. It is said that by the use of this apparatus one man can pick 1,000 pounds of seed cotton in a day of ten hours.



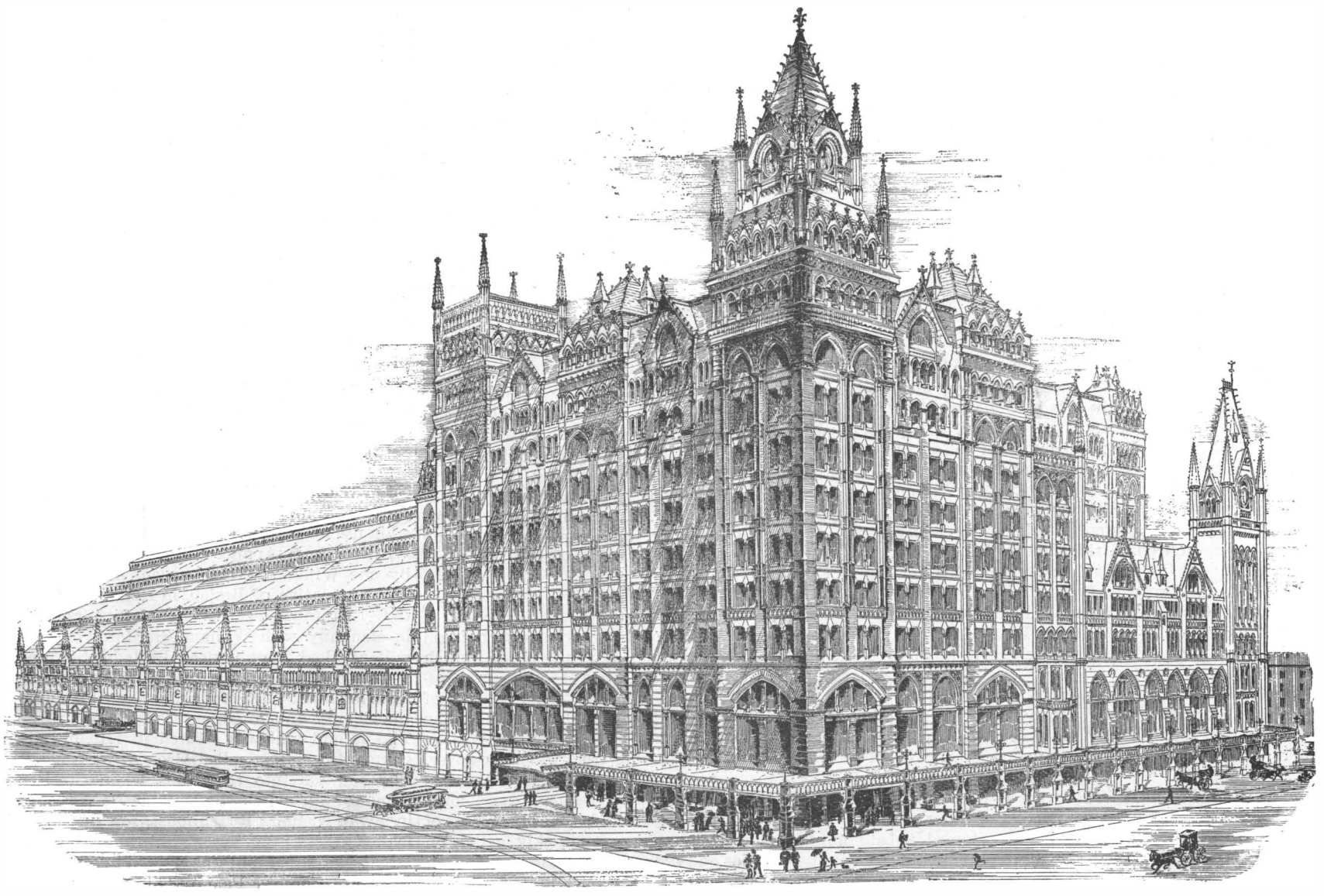
HYDE'S COTTON PICKER.



HYDE'S COTTON PICKER—MECHANISM OF THE PICKER."

Varnish for Celluloid Negatives.

We are often asked for a formula for a varnish for negatives on celluloid films that will not attack the celluloid. Here is one that answers well in our hands: White lac, or pale orange lac, four ounces; methylated spirit, eight ounces. When dissolved, add liquor ammoniæ, six ounces, and boiling water half a pint, and afterward a drachm and a half of glycerine. This solution may be filtered, or it may be allowed to stand and settle and the clearer portion decanted. It will generally have a somewhat opalescent or turbid appearance, but that may be disregarded, as it will not affect the negative. The mode of using is this: After the negative has been fixed and washed, it is thoroughly drained. The varnish is then poured into a dish and the negative immersed and allowed to soak for a few minutes. It is then taken out and pinned by one corner to the edge of a shelf or other convenient article to dry. This varnish will also answer for negatives on glass, and it may be applied while the film is still moist; but, on the whole, for glass negatives a good spirit varnish is to be preferred.



NEW BROAD STREET STATION OF THE PENNSYLVANIA RAILROAD, PHILADELPHIA PA

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Mistakes in a Boiler Room.

The *Locomotive* tells the following story, and the editor vouches for its accuracy:

A short time ago our attention was called to some most remarkable doings in a boiler room, which we proceed to relate. The boiler was originally built to furnish power, and was good for about 75 pounds steam pressure; but it is now used only for heating purposes. Some of the steam and return valves to the large coils leaked about the stems, and the owner of the boiler, instead of sending for a steam fitter to repack them, called in a plumber. The plumber, being busy, sent his boy helper. The boy began work on some of the valves that were within sight of the boiler front, but being troubled by the steam that escaped, he shut off the steam valves, leaving the return valves open. The coils were large, and when the steam in them had condensed, water began to back up from the boiler, for there was no check valve on the returns. As the boy worked away he noticed that the water in the gauge glass was going down somewhat rapidly, and also that the steam pressure was rising. He did not know where the water was going to, nor did he know how to feed it more; but he thought that if he opened the furnace door, and so checked the fires, the evaporation and the rise of pressure would proceed much more slowly. Jumping down into the pit in front of the boiler, he opened what he thought, in the darkness, were the fire doors, but it appeared subsequently that he did open the ash-pit doors, this making matters worse instead of better. The fire brightened up and the pressure began to rise rapidly and the water level to go down. The boy was greatly troubled at this, and when the rubber diaphragm in the damper regulator burst from the increasing pressure, he "went all to pieces," as the saying is, and ran for his boss.

The boiler being originally intended for furnishing power, the safety valve could not be set to blow at less than about twenty pounds, while the damper regulator was designed to carry not more than six pounds or seven pounds, so that its diaphragm burst, naturally enough, before the blowing-off point of the safety valve was reached. The plumber came in haste and found the people in the building overhead badly frightened, and the boiler room filled with steam, so that he could not make out precisely what had happened. He told the boy how to turn on the feed, however, and that well-meaning but badly "rattled" individual went to the back end of the setting, and, instead of opening the plug-cock in the feed pipe, he opened the plug-cock in the blow-off pipe, which only added to the noise and confusion. Meanwhile, the plumber hauled the fire out onto some pine boards that the regular attendant had laid in the damp pit. The boards took fire, and smoke was soon added to the escaping steam, to the intense horror of the occupants of the building, who by this time were on the other side of the street. When the fire had been hauled and the danger averted, the plumber soon learned the cause of the disturbance, and quiet was speedily restored by shutting off the damper regulator and the blow-off, and throwing a few buckets of water on the burning boards. It seems hardly possible that such a succession of mistakes could follow one after another in so orderly a manner, but we can testify, from personal observation, that they did. And we may add that not long afterward, when the boiler was out of use, a coal dealer put 100 tons or so of coal into the same boiler room, piling it up in such a manner that some of it ran down into the open manhole, and the rest of it covered up the blow-off pipe and the rear door of the setting, which were both open, so that there was plenty of trouble digging them out before the boiler could be started again.

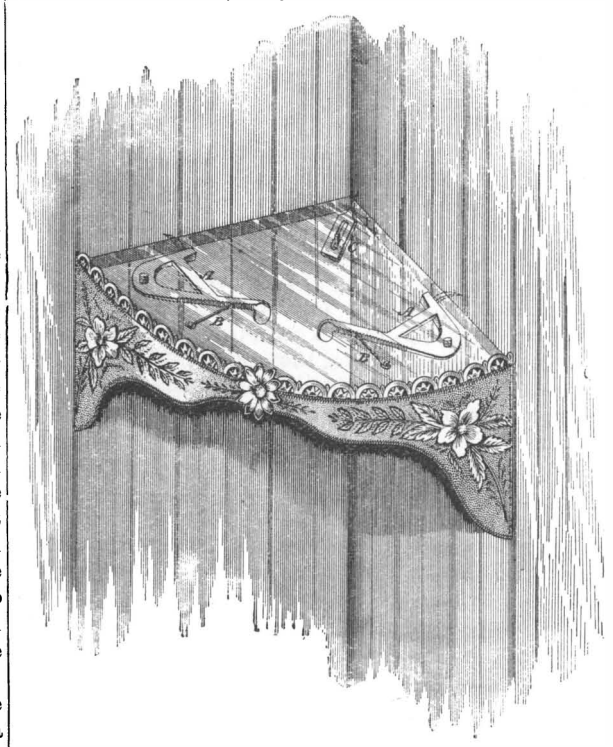
The Art of Thinking.

Did you ever notice how bunglingly some men think? There is as much or more difference in the way men use their mental faculties as there is in the way they use their tools. Just as one man will proceed deftly and systematically to the accomplishment of a piece of work with everything conveniently at hand, every motion intelligently directed to the furtherance of the main purpose, and an expedient ready for every irregularity or difficulty which presents itself, so the ready thinker proceeds at once in a right line to the pith of a subject, sifting out the extraneous matter, defining the main point, and bringing to bear upon it all his available information. On the other hand, a clumsy thinker will chase a question up one side and down the other, without getting anywhere or arriving at any relevant conclusion.

The mental like the manual faculties are susceptible and require cultivation. It is only by practice and continual use that the dexterity and skill of the expert machinist or other manipulator are acquired. No matter how naturally ingenious and handy a man may be, he will lack deftness when placed upon work to which he is entirely unaccustomed. In order to think with facility a man must be accustomed to thinking. It is one thing to let the mind roam about among the things one knows, and another to put it hard at work and keep it there, grinding at something you do not know, but want to. It is easy and entertaining to read an article which tells you something which you knew before and which you can indorse, but you learn nothing by reading it. It requires an effort to read an article which contains real information, however plainly expressed. It has to be studied, applied, digested, criticised, the suggestions raised by its perusal have to be followed out to their conclusions, and to conscientiously read an article of this character is a task which a man is inclined to shirk just as a lazy man might shirk a physical task. But compare the man who shirks with the man who reads, and you will find in the first a mental bungler, in the second the acute and able thinker, the man whose head saves his hands and who is valued, respected, and trusted with the conduct of work and the administration of affairs, and rewarded accordingly. Always read a little ahead of yourself. Read matter which requires an effort upon your part to understand. The effort will not only place you upon a higher intellectual plane, but the mental exercise will develop a habit of accurate thinking which will be of more value to you than volumes of average matter read only to be forgotten.—*Power.*

AN ADJUSTABLE CORNER SHELF.

The illustration represents a corner bracket she having simple attachments adapting it for a secui but removable connection with the walls of a room, without the use of tools. In the picture the shelf itself is shown as made of glass, through which may be seen the locking devices on its under side, whereby the shelf is secured in position in the corner of a room. The shelf, however, may be made of wood or other



LEGG'S CORNER BRACKET SHELF.

material, and in several pieces hinged together, so as to be collapsible, that it may be packed in small space. The locking mechanism for engagement with the side walls consists of pivoted D-shaped pieces, A A, on one member of each of which is a prong adapted to enter the wall, while the other member has a toothed surface to be engaged by a pawl, B, after the prong is forced into the wall, a thumb-piece forming the end of this member, and facilitating the forcing of the prong into the wall. Near the rear angle of the shelf a slotted pin, C, is secured in position to be conveniently projected or withdrawn, by means of a screw passing through the slot. The ornamental front edge of the shelf is removably secured in position by pins engaging slots in the upper border. It will be seen that this shelf can be quickly put up or taken down, being placed where it will afford the best position for displaying bric-a-brac, etc., thus also utilizing and ornamenting unused corners. The improvement has been patented by Mr. J. D. Legg, of Long Eddy, N. Y., of whom further particulars may be obtained, and the shelf is being manufactured by the Joy & Seliger Co., of Newark, N. J.

Tripe.

We have been challenged to pronounce an opinion on the dietetic virtues of tripe, an article of food which is largely consumed in certain parts of the country, especially during the winter months. Tripe consists of the soft muscular walls and mucous membrane of the stomach of ruminant animals, with a small proportion of delicate omental fat adhering, from which, however, all fibrous portions of the serous covering, or peritoneum, have been removed. From frequent experiments it has been proved that tripe stands high in the list of albuminous substances that are quickly acted on by the gastric juice and reduced to a state of solution, and has, therefore, acquired a reputation for digestibility. But plain boiled tripe in itself is a very insipid article of food, and in order to make it palatable the art of the cook has to be invoked, which, while making it more "savory," causes it often, when so served, to be an offense to the stomach. The usual mode of serving tripe in this country is to boil it with milk and onions, and there can be little doubt that such a combination is not particularly digestible. Tripe is also sometimes fried in batter, but unless very carefully cooked it is apt to become leathery. If only plainly boiled in water it requires a considerable amount of condiments in the shape of salt, pepper, and mustard to make it acceptable to the palate. Therefore tripe, as usually cooked, though an excellent dish for strong stomachs, is, owing to the ingredients added to it, not always so suitable for persons of weak digestion as has been supposed.—*Lancet.*

Something About Paper Making.

A handsomely illustrated pamphlet on paper making has lately been issued by Messrs. Vernon Brothers & Co., the well known paper dealers of this city, from which we take the following:

For many centuries the stalks of the papyrus were used by the nations living about the Mediterranean in the manufacture of a material which served them for writing upon, and for wrapping purposes.

The papyrus is an aquatic plant having a soft cellular flower stem. This stem, of a triangular shape, grew from ten to twenty feet in height, and from its thin coats or pellicles the paper was made. These were separated by means of pins, or pointed mussel shells, and spread on a table sprinkled with water. On the first layer of these slips a second was placed crosswise, so as to form a sheet of convenient thickness, which, after being pressed and dried in the sun, was polished with a shell or other hard and smooth substance. Twenty sheets was the utmost that could be separated from one stalk, and those nearest the pith made the finest paper.

The principal manufacture of papyrus was carried on for a long time in Alexandria, and Europe and Asia were supplied therefrom during several centuries.

The art of making paper from fibrous matter reduced to a pulp in water appears to have been first discovered by the Chinese about eighteen hundred years ago. Chinese paper is made from the inner bark of the bamboo and mulberry trees, hempen rags, etc.

One description of the bark paper of China is as follows:

"The small branches of a tree resembling the mulberry (Broussonesia) are boiled in lye to loosen the bark; this is then macerated in water for several days, the outer part scraped off, and the inner part boiled and agitated in lye until it separates into fibers. It is then washed in a pan or sieve and worked by the hands into a pulp, which is afterward spread upon a table, and beaten fine with a mallet. The pulp is next placed in a tub containing an infusion of rice and a root called *oveni*, and thoroughly stirred to mix the materials. The sheets are formed by dipping a mould made of strips of bulrushes confined in a frame into the vat containing the pulp, and are, after moulding, laid one on another, with strips of reed between. A board and weights are laid on the pile to express the water, and they are then separated and dried in the sun."

The Saracens are supposed by their conquests in Bucharia, about the year 704, to have acquired the art of making cotton paper, and substituted it for the papyrus. In the eighth century the Saracens conquered Spain, and through that peninsula the art of making paper reached the rest of Europe.

The oldest manuscript written on cotton paper in England is in the Bodleian Collection of the British Museum, and bears date 1049. The most ancient manuscript on the same material in the Library of Paris is dated 1050. In 1085 A.D. the Christian successors of the Spanish Saracens made paper of rags instead of raw cotton, which is recognized by its yellowness and brittleness. A very early specimen of linen paper is found in a manuscript bearing date 1100 A.D.

In 1390 Ulman Strother established a paper mill at Nuremberg, in Bavaria, operated by two rollers, which set in motion eighteen stampers. This indicated the process of pulping the fiber by beating, which continued in use for nearly four centuries.

In 1690 the first paper mill was established in America by one William Rittinghuysen, now spelled Rittenhouse, a native of Broich, in Holland, who emigrated to Germantown, Pa., being one of its first settlers. He, in company with William Bradford, established the mill at Roxborough, near Philadelphia, on a small stream called Paper Mill Run. The paper was made from linen rags, the product of flax which was raised in the vicinity and manufactured into wearing apparel. The second mill was erected in 1710, in that part of Germantown, Pa., called Crefeld, on a small stream that emptied into the Wissahickon Creek, near the manor of Springfield, by William De Wees, a brother-in-law of Nicholas Rittenhouse, son of the first paper maker.

In 1729 a paper mill was erected upon Chester Creek, Delaware County, Pa., by Thomas Wilcox. In 1870 paper was still made there by hand. The first paper mill of Massachusetts with legislative aid was erected

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in 1730, at Milton. Daniel Henchman, an enterprising bookseller of Boston, was the probable owner. In these early stages of the paper development rags were scarce, the importation not being thought of, and people were exhorted in all ways to save their rags.

In 1769 it was announced in the Boston *News Letter* that "the bell cart will go through Boston before the end of next month to collect rags for the paper mills at Milton, when all people that will encourage the paper manufactory may dispose of them!" The following lines were appended to stir the public zeal:

"Rags are as beauties which concealed lie,
But when in paper how it charms the eye;
Pray save your rags, and beauties to discover,
For paper truly every one's a lover.

By the pen and press such knowledge is displayed
As wouldn't exist if paper were not made,
Wisdom of things mysterious, divine,
Illustriously doth on paper shine."

At the beginning of the revolution there were three small mills in Massachusetts and one ("out of repair") in Rhode Island. The amount of paper turned out, of course, fell far short of the demand, and the quality was poor. The people had not acquired the habit of saving rags, and, therefore, stock for the manufacturer of paper was obtained with great difficulty. Everything that could possibly be used for the purpose was ground up with the rags, and the result, both in color and texture, was sometimes peculiar, to say the least.

The Massachusetts House of Representatives, in view of the scarcity of paper, resolved that the Committees of Correspondence, Inspection, and Safety of the several towns be required to appoint some suitable person in each town to receive rags for the paper mills, and the inhabitants were desired to be very careful in saving even the smallest quantity of rags proper for paper making. During the war the paper makers were exempted from military duty.

In Pennsylvania the Council of Safety took measures to prevent the paper makers from joining the volunteers about to march to New Jersey, Congress having resolved that they should be detained, the demand for paper money having then come into existence.

Paper was so scarce when the American army entered Philadelphia, upon the evacuation of the British troops, that there was a want of paper fitted for the construction of cartridges. It was advertised for, and but a small quantity procured. An order was then issued demanding its instant production by all people in that city who had it. This produced but little more, very probably on account of its scarcity. A file of soldiers was then ordered to make search for it in every place where any was likely to be found. Among other places visited in July was a garret in the house in which Benjamin Franklin had previously had his printing office. Here were discovered about five hundred copies of a sermon which the Rev. Gilbert Tenant had written (printed by Franklin) upon "Defensive War," to arouse the colonists during the French troubles. They were all taken and used as cases for musket cartridges, and at once sent to the armory. Most of them were used at the battle of Monmouth.

The cylinder machine is believed to have been first used by Thomas Gilpen & Co., at Wilmington, Delaware. This was put in operation on the Brandywine, and was an American invention.

It was stated the machine would do the work of ten paper vats and deliver a sheet of greater width than any other made in America, and of any length required. A great impetus seems to have been given to paper manufacturing by the introduction of machinery, and changes in the mode of manufacture as well as in the materials used. Rope, hemp, tow, bagging, raw cotton, cotton waste, colored and filthy rags and other material, which had been previously used only in the manufacture of coarse papers, were gradually brought into use for the finest grades, by the introduction of chlorine and other means of cleansing and bleaching.

The modern improvements, such as drying cylinders, cutters, etc., were first introduced by David Ames, of Springfield, Mass. At the time of his death, machinery was in general use, there being but two vat mills of any note engaged in making paper by hand, and those were employed in producing peculiar sorts requiring great strength and firmness.

In 1856 it was estimated that the United States produced 200,000 tons of paper, against 66,000 tons in Great Britain and 70,000 tons in France. It was also estimated in the same year that if all the paper consumed in one year by the newspapers in the city of New York was put upon wagons containing two tons each, they would form a procession thirty miles in length, requiring six thousand wagons.

The industry up to the time of the rebellion had extended marvelously. The war coming on increased the consumption largely.

Paper which had actually been sold for nine cents a pound was gradually increased to twenty-two of the ordinary news quality, notwithstanding a vast quantity of old paper was procured from all quarters for stock.

During the war, 1861–1864, prices were so high that enormous profits were made, and all those owning mills became wealthy.

As a consequence, many people went into the manufacturing: mills were multiplied amazingly at every available water power; all sorts of enterprises for the manufacture were started—wood pulp, straw pulp, bamboo, side flags, etc.

In 1800 a reward of 8,000 francs was granted by the French government to Robert for the invention of what is known as the Fourdrinier machine. Donkin completed his first machine, acting on the ideas of Robert, in 1803; and in the succeeding year Henry and Sealy Fourdrinier (wealthy stationers of London) purchased the patents of Didot and Gamble. These gentlemen may be considered the great introducers of machine-made paper, and, like many other projectors, were rewarded by impoverishment.

It was Mr. Thomas Barrett, of St. Mary's, England, who obtained a patent for inserting the water mark and maker's name to a continuous paper, so as to resemble in every respect paper made by hand. This ingenious man also invented a mode of making iron rolls for finishing paper.

The methods of producing paper have been revolutionized within a few years by the invention of wood pulp. There are three kinds used—ground wood, soda-process wood, and sulphite-process wood; the two latter are not wood in either physical or chemical properties, but cellulose, similar to cotton in appearance and nature.

Ground wood was first invented in Germany in 1847, perfected by Voelter to a certain extent. It was produced by shredding the fibers from blocks of wood held against a sharp grindstone by hydraulic pressure, a stream of water pouring down upon these stones carrying away the pulp. Spruce, poplar, and other white woods are used. The process was introduced into this country by A. Pagenstecher, about 1861, when Senator Warner Miller and Wm. A. Russell commenced its use at their mills.

Very little could be used, as made by the German process. Messrs. Geo. E. Marshall, Wm. A. Russell, and Chas. W. Wheelwright in experimenting found that by using a coarse grinding stone and doubling the power, a pulp was produced that could be worked into news to the extent of seventy-five per cent. The cost of pulp has been reduced from 7 cents per pound to 1½ cents at the present time. This improved the quality of the paper made, besides cheapening the cost of production; and without wood pulp it would be impossible to supply the demand for paper at the present day. The introduction of ground wood has lowered the price of news paper from 15 cents to 3¾ cents for such paper as is used by the New York *Evening Post*, and such paper as is used by the New York *Sun* to 3 cents, giving an almost opaque paper, soft for rapid printing. The production of ground wood is enormous in this country and in Canada, Germany, Norway, and Sweden. Nearly every stream in the forest regions has a pulp mill.

Soda-process wood makes the best papers—they cannot be distinguished from those made from fine cotton. Nearly all the best book papers contain a large proportion of this wood, as do most writing papers. The soda process was invented in France by M. Meliner, about 1865. White, resinous woods are used; spruce and poplar most extensively. The blocks of wood are cut into large chips, boiled in a strong solution of caustic soda under pressure, which leaves a fine, soft, fibrous cellulose. Small quantities of this pulp cannot be detected in paper except by the polarization of light in a microscope. It is now made in all the Eastern States. The manufacture of soda wood pulp was not a profitable one until the Yaryan system of evaporation was developed by Col. A. G. Paine, in 1886, by which the recovery of alkali was accomplished at a very low cost. Some of the most extensively used papers are made entirely of soda wood pulp, those suitable for weekly trade and religious newspapers selling from 5 to 6 cents per pound.

Sulphite wood pulp is made by the acid sulphite of lime process. Its manufacture was first attempted and invented by Tihlman, the celebrated chemist of Philadelphia, who made extensive experiments and then abandoned it. It was next made in Europe, by Franke, in Norway, about 1873. Eckman invented a process of bisulphate of magnesia, but this process is not used in this country. The experiments were taken up again by Mitterlich, Rittenur, and Koehler, in Germany, and wood pulp was extensively made by them. It was first introduced into this country by Chas. W. Wheelwright, of Providence, R. I.

It is sometimes said by those not posted that English papers are better; this is not so. American book, news, and writing papers are in the higher grades the best that are made. Our wise protective policy has stimulated invention and production until we have now the best paid operatives and we make the best quality. It takes the best quality of brains to make uniformly good paper.

We now export news paper to various parts of the world and at the prices ruling here, the foreigners paying the freight. Large quantities of paper are now exported to England, Ireland, Australia, Mexico, and the West Indies.

Scientific Research in Medicine.

Numerous plants which had once a most evil reputation, and were shunned on account of their virulent poisonous properties, have of recent years been made subservient to the wants of man. The umbsuli, a species of strophanthus which yielded the well known South African arrow poison, has been found of incalculable benefit in cardiac disease. Urari, another arrow poison, obtained from *Strychnos toxifera*, a native of the Orinoco and Amazonian forests, probably mixed with the juice of other species, is one of the most valuable of the drugs used in physiological experiment. The celebrated ordeal bean of Old Calabar, *Physostigma venenosum*, a plant so deadly as to be ordered to be destroyed by a thoughtless government, has yielded under careful research a powerful sedative to the spinal cord and valuable agent in ophthalmic cases. Another African ordeal poison was yielded by *Erythrophlæum guineense*, the sassy of the Gambia, and casa of the Congo. The bark on infusion yields "red water," the material used in the ordeal. In medicine casa is useful in the treatment of cardiac dropsy and hemorrhage. One of the most deadly plants of the West Indies, formerly a stock poison of the Obeahs, and probably still in use in Hayti, is *Urechites suberecta*. Now this plant is recognized as a cure for yellow fever. Jamaica dogwood (*Piscidia erythrina*) used by natives as a fish poison, appears in the United States Pharmacopœia as an anodyne and hypnotic. These are only a few of many instances in which plants formerly used destructively against human life have now become subservient to its preservation and resuscitation. Then again, to glance at the counter side of the poison question, consider the number of plants from which we may now obtain antidotes to both vegetable and animal poisons. A cucurbitaceous plant of the West Indies (*Fevillea cordifolia*) will expel the poison of the cacoon. The juice of *Oxalis corniculata* relieves the intoxication produced by datura seeds. Even Calabar bean is said to be an antidote to strychnine poisoning. The machioneel tree, more deadly than the famous upas, grows side by side with its antidote—white wood cedar, a species of tecoma. Not content with extracting and analyzing natural *simplicia*, we actually venture to compete with nature, and enter the lists against her as manufacturers. Indeed, chemists confidently look for the day when all alkaloids will be artificially synthesized, and anticipate the time when medical diagnosis will have only to tell us just what is the matter, and chemistry will straightway answer, "Here is the requisite cure manufactured to suit the case."—*Prof. R. J. Harvey Gibson.*

Removing Ornamental Trees.

In lifting and removing large ornamental trees, great care is requisite not to cut, bark, or otherwise injure the roots in course of the operation; and in order to guard against such a contingency, I have been in the habit of using digging forks for this purpose in preference to spades, by which means the risk of damage is lessened to a considerable extent. In planting the trees, should the soil be poor and exhausted, some rich friable loam should be brought and mixed with the soil. This will have a beneficial effect in promoting the growth of the trees. The roots should be well spread out in all directions from the base of the stem, and care should be taken to see that they do not cross or in any way overlap each other. Stake, tie, and fence the trees according to their requirements, and apply a good mulching to prevent a too sudden evaporation; and, if thought necessary, finish by erecting a screen cage of branches around the tree to shelter and break the force of the wind until such time as the roots take to the soil and get established. A very efficient shelter may be erected for this purpose by placing four upright posts in the ground at right angles, and at a reasonable distance from the tree; then, by nailing on say three or four horizontal rails, and warping in a few branches, a useful screen can be formed at small cost, and on exposed situations will be found highly beneficial to the trees.—*The Garden.*

Physiological Experiments with Great Magnets.

At the Edison Laboratory Dr. Fred. Peterson and A. E. Kennelly have sought to prove that no therapeutic effects are resultant from the application of magnetism to the human system. For the purpose of experiment the armature was taken from a dynamo, and in the cylinder formed by the inner ends of the set of powerful converging field magnets a dog was confined and kept for a period of five hours. The intensity of these magnets was from 1,000 to 2,000 c. g. s. lines to the square centimeter. At the end of the time mentioned the dog was set at liberty, and beyond his apparent joy at thus being set loose the operation did not seem to affect him in the least.

A boy was also confined for a short time in the same position and was also uninfluenced. Several other experiments of like nature were made. Dr. Peterson and Mr. Kennelly conclude from their experiments that the human organism is in nowise affected by the most powerful magnets known to modern science.

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HERON HUNTING.

Heron hunting is a sport which has almost sunk into oblivion, but now seems likely to be brought into vogue again, for the Emperor William has declared his intention of using falcons in hunting the herons that are so numerous in the neighborhood of Konigs-Wusterhausen. This species of chase, which is not to be confounded with hawking, is conducted as follows: A number of ladies and gentlemen, who are to accompany the chase as spectators, assemble on a large heath or plain over which the herons pass daily, with a certain regularity, in going from their fishing grounds to the heronry. A few steps from them are the falconers, usually two or three, each one carrying on his gloved hand a hooded and fettered falcon. Near the falconers are servants who carry light wooden frames on which are reserve falcons, also hooded and fettered. On an elevation in the distance is a single rider who acts as a sentinel and whose duty it is to signal to the falconers the approach of a heron. He does this by alighting from his horse as soon as he discerns the bird coming from the fishing place or the woods, and turning his horse's head in toward the heron. The falconers then move slowly from two sides in the direction indicated and allow the heron to pass quietly above and between them, then the hoods are removed from the falcons' heads, and as soon as they have descried the prey, their fetters are taken off and they are "thrown." The falcon seldom flies directly toward the heron, but generally moves rapidly at a moderate height above the ground until near its prey and then mounts. As soon as the heron notices that he is pursued, he tries, in case he is coming from fishing, with a full crop, to lighten himself by stretching out his neck and throwing out the fish that he has swallowed, and then as he knows by instinct or experience that the falcon will fall on him as soon as it succeeds in reaching a higher point, he uses all his strength to fly higher than his pursuer. Sometimes the heron succeeds in doing this, and then he vanishes in the clouds, but he is generally overtaken by the falcon, which then, quick as an arrow, rushes on the heron and tries to seize him by the neck or wing. The first attempt is often unsuccessful, because the heron skillfully avoids the falcon at the critical moment. This gives him an advantage, for the falcon is frequently carried far below him by the force of its movement, but now a second falcon comes to the assistance of the first one, and then follows swoop upon swoop until the heron gives up all resistance and with outstretched legs and raised head lets itself fall perpendicularly. Sometimes one or both of the falcons cling to the heron, and then all fall together in a confused mass. At some distance from the ground the falcons release their hold on their victim so as to avoid the shock of the fall, but the next minute they are hanging on him again. During flight the heron does not use his sharp-pointed beak, but as soon as he feels firm ground under him he uses it in a vigorous defense. Formerly a rough-coated greyhound was taken on heron hunts which was trained to catch and hold the heron by the neck as soon as it fell. If the heron is not severely wounded in this fight, he is given his freedom after a ring bearing the date and the names of the huntsmen has been fastened on one leg.

In the middle ages falconry was a favorite sport in all the European courts, but it was given up in France during the reign of Louis XIV. and in Prussia in the time of Frederick the Great. In the smaller German courts, however, it was practiced until the end of the last century.

Falconry (called by the French *la haute volerie*) should not be confused with the ordinary hawking (*la basse volerie*). For the latter, low-flying birds, such as hawks, are used, and also a dog to act as a retriever, the prey being grouse, hares, and water fowl. In England there are many "hawking clubs."

The terminology of falconry and hawking is extremely complicated, especially in regard to the names given to the birds, which depend not only on their species, but also on their age, the time of catching and training, and the nature of the game they hunt. The literature relating to the subject is very rich. James C. Harting's illustrated "Bibliotheca Accipitraria," which was published in London last year, brings the number of works on falconry up to 378. The first book published in Europe on the subject (1245) was the celebrated work of the Emperor Frederick II., "De Arte Vendandi cum Avibus." The beautiful work of Schlegel and Wouwerholt, "Traité de Fauconnerie," appeared in 1853, in Leyden and Dusseldorf. —*Illustrirte Zeitung.*

HERON HUNTING—ORIGINAL DRAWING BY LUDWIG BECKMANN.

Gooseberry Rats.

Mr. G. Reade, in the *Zoologist*, says that the ripe gooseberries in his garden were disappearing very rapidly this year, and he supposed that the mischief was being done by blackbirds. However, his attention was called to a large rat taking the berries off with his mouth and dropping them to other rats below. Presently another climbed the tree and helped to gather the berries. In a little time both came down each with a berry in its mouth, having a curious appearance. Mr. Reade saw the performance several times repeated. Then he placed a wire cage under the tree, and in three days caught nine of the intruders.

Kerite.

At certain intervals solutions of rubber in paraffine wax are brought out as insulators, and a substance of this kind has been called "kerite." Rubber dissolves slowly in paraffine wax and forms a compound combining the properties of paraffine wax and the original rubber. It will be found that very little rubber goes a long way in this compound. Some time ago one of our staff experimented on the vulcanization of this substance. Paraffine wax does not dissolve sulphur, so a little was dissolved in anthracene, which dissolves it easily and mixes with paraffine without precipitating the sulphur. The solution was thus vulcanized into a gray substance. This does not melt properly, but one of its most curious properties is its adherence to glass. The beaker in which the vulcanization was carried out fell, but the glass did not separate from the compound. The beaker was then battered into little pieces purposely, but they adhered strongly to the compound. As paper and waxed paper are now so much thought of as insulators, it is likely that paper saturated with kerite may become of considerable use. Its properties are, no doubt, very well known to those who make it; but, unfortunately, such matters are generally kept secret for commercial reasons.—*Industries.*

Interesting Gun Trials.

According to the Reading (Pa.) *Times*, some rather surprising results were lately obtained with a new multicharge gun, of Haskell's pattern, half-inch bore. The trial took place at the Kurtz House proving ground. A solid hammered wrought iron target, 7½ inches thick, was penetrated entirely through, backed by a boiler plate ⅜ of an inch thick, which was also penetrated through, making a penetration of 7⅞ inches. The shot was made of Carpenter steel, and the charges of powder were 10 ounces.

This penetration is nearly sixteen times the diameter of the projectile, or more than four times greater than has ever been obtained by any other gun.

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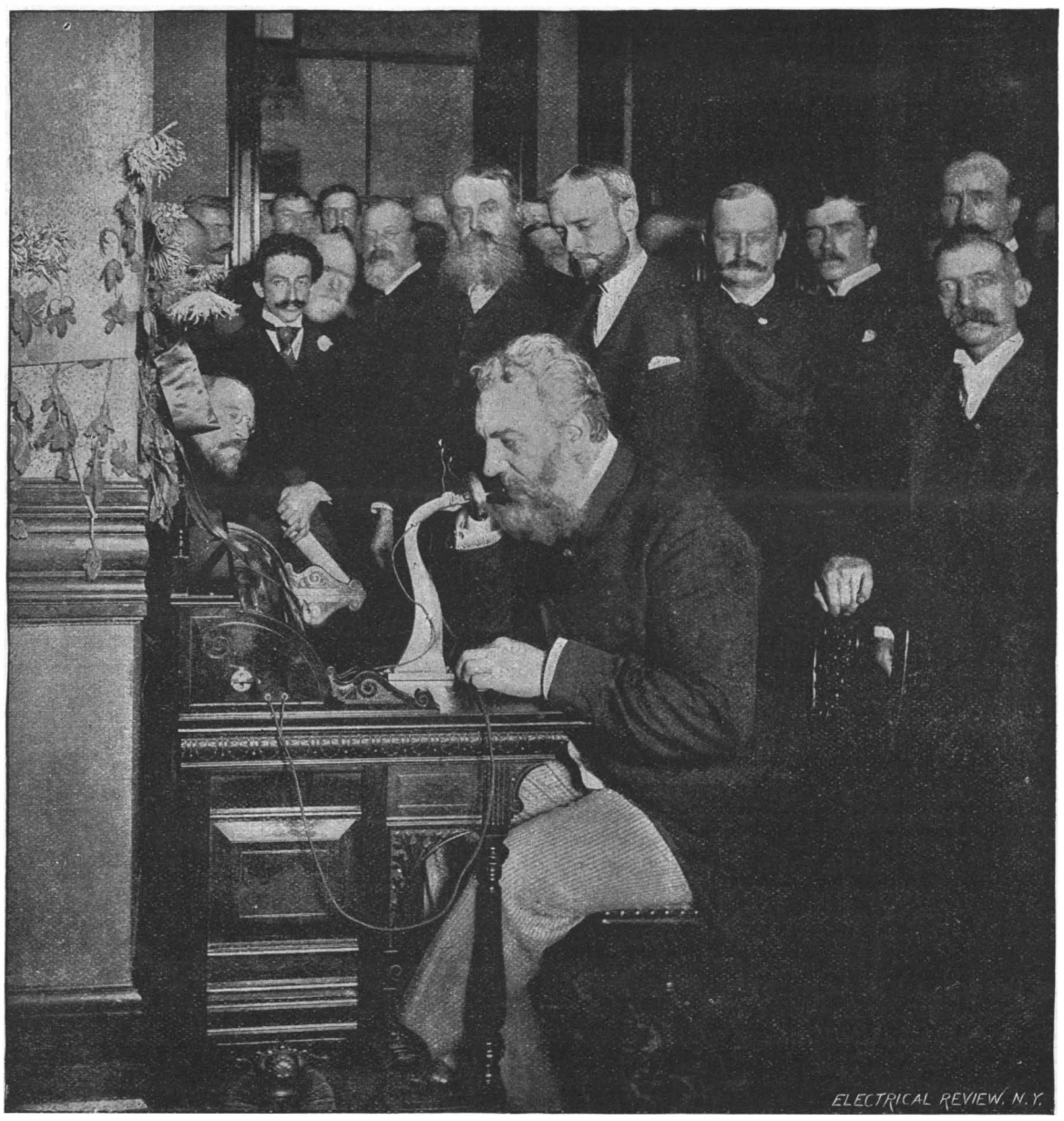
TALKING BETWEEN NEW YORK AND CHICAGO.

In the account of the opening of the telephone line between New York and Chicago as given in our last number, we mentioned the interesting fact that Prof. Bell was photographed by flashlight while talking with Mr. William H. Hubbard, at Chicago, a distance of nearly 1,000 miles. Our illustration, from the *Electrical Review*, is reproduced from the flashlight photograph and is interesting historically as showing the advances made in both sciences, telephony and photography. Directly back of Prof. Bell stands President John E. Hudson, of the American Telephone and Telegraph Company, and at his right is Mr. E J. Hall, the Vice-President and General Manager.

It happened that at the time of the great Milwaukee fire on the 28th ult., the long distance lines were completed between Chicago and Milwaukee, which enabled the general superintendent, Mr. A. S. Hibbard, in his office at New York the next morning after the fire to give directions verbally by telephone in regard to the necessary repairs to the superintendent located in the suburbs of Milwaukee.



PROFESSOR BELL TALKING BY TELEPHONE FROM NEW YORK TO CHICAGO.

PROPOSED DESIGN FOR AN ATLANTIC PASSENGER STEAMER.

BY JAMES GRAHAM.

The question of transatlantic passenger traffic is one assuming greater importance from year to year with the rapidly increasing travel from America to Europe.

A large proportion of the seventy millions of people in this country and Canada would, doubtless, like to cross the ocean if they could do so with greater comfort and less expense.

The great steamship companies have attempted to meet the demand by putting on larger and faster steamers, but they have not reduced the rates; on the contrary, the rates are higher, owing to increased cost of running such steamers.

The large steamers that are being built will probably mark the limit to profitable advance in size and speed with the present model of Atlantic passenger steamers. Greater speed necessitates greater length, breadth, depth and draught. The limit of draught suitable for harbors will soon be reached. Moreover, the increase of tonnage, propelling power, and cost is at a much higher ratio than that of the passenger capacity.

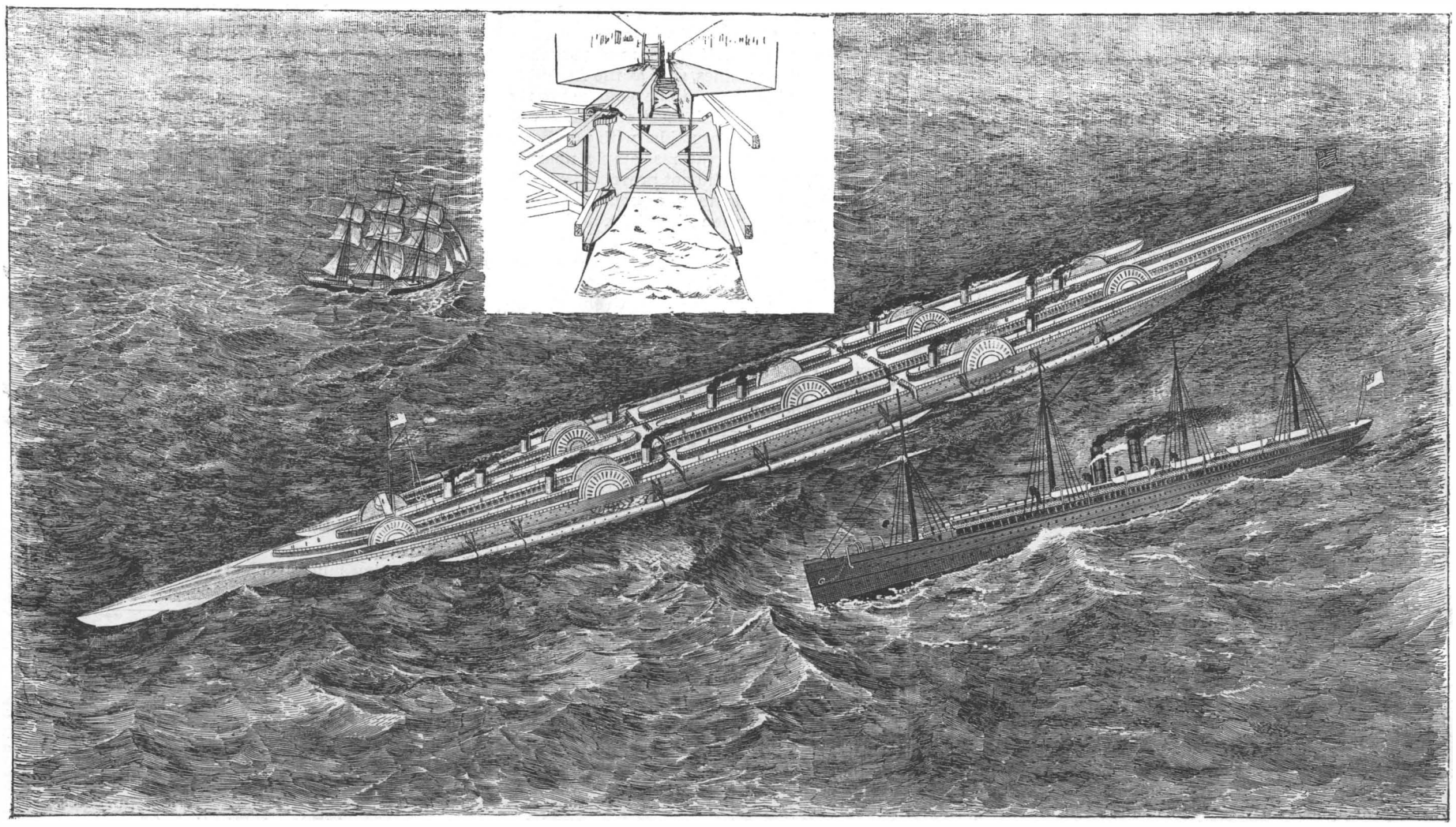
Ten years ago $750,000 was about the cost of the large ships, then the cost rapidly advanced with the rivalry in speed, till now they cost $2,000,000, and the latest Cunarders will cost half a million more, while those of the White Star line will be at least $3,000,000. The passenger area of a 700 foot steamer is not much greater than that of one of 580 feet, and the speed will be only about two knots faster.

Our engraving illustrates a new design for an Atlantic passenger steamer in which greatly increased length is secured without proportional increase of draught and beam.

The proposition is to construct a system of nine hulls of special model connected in three trains of three hulls each, the center train being the principal part of the craft, and extending 225 feet forward and 200 feet abaft of the other two trains, the whole forming an outline similar to that of an ordinary ship. The total length would be 1,440 feet, breadth over three trains 142 feet, to outside of floats 180 feet.

Midship draught of center train, 18 feet; midship beam at water line, 45 feet; midship beam at main deck, 60 feet; midship draught of outer trains, 12 feet; midship beam at water line, 27 feet; midship beam at main deck, 35 feet; displacement of center train, 15,000 tons; of outer trains, each, 5,250 tons; total displacement about 26,000 tons. The propelling power would consist of seven engines, three in center train of 10,000 horse power each; two in forward sections of outer trains, 4,000 each; two in stern sections, 6,000 each. A total of 50,000 horse power, driving seven pairs of paddle wheels of 52 and 56 feet diameter, 6 and 8 feet wide, and having a dip of 8 feet.

This steamer would carry no cargo, and, owing to the system of construction, would require no ballast, so that the entire tonnage capacity would be



GRAHAM'S DESIGN FOR AN ATLANTIC PASSENGER STEAMER.

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available for engines and fuel. She would be intended for only first and second class passengers, and have accommodation for 2,000 of each.

The sections would be held in position by a system of flexible connectors, consisting of massive steel transverse girders, 10 feet deep, having rocker ends bearing against uprights connecting the upper and lower decks. The ends of the rockers would bear against a series of heavy half elliptic springs, having a flexible strength of 50 and 75 tons each. These springs would extend along the upper and lower decks, and would stiffen and check the motion of the rockers. A strong wire cable would be fastened in the end of the rocker, then pass over a roller secured in the upper deck, thence down under a similar roller in lower deck and connect with the other end of the rocker. A second cable would be fastened to the inner side of the spring, pass around the roller and connect with the rocker, so as to act reciprocatingly. The beams connecting with the girders would be braced transversely and run diagonally throughout the sections. The longitudinal connectors of the sections would be a single massive coupler in center of each section, placed on a level with the center of the lateral connectors and 12 feet above the water line. The longitudinal frames of the sections would converge at the point of connection. The coupler and the frames diverging from it would, of course, have to be of immense strength and capable of sustaining a strain of one or two thousand tons. The space between the ends of the connecting hulls would gradually widen from the connector down to the keel plate, where it would be about 5 or 6 feet on a level keel, which would admit of a depression of the stem of the center train of 120 feet. This space would be occupied by a metal and rubber water-tight chamber that would expand and compress with the vertical motion of the ends of the hulls, and prevent the water from filling in between the ends.

There would be hinged to the bottom of the forward section sliding plates that would extend under the bottom of the adjoining section, thus forming an even and continuous bottom from stem to stern of each train.

It is estimated that 5,000 tons of steel would be used in the construction of the connectors and in the strengthening of the parts of the sections where the greatest strain would occur. The hulls would be entirely of steel.

It is thought that a steamer of this design could be built sufficiently strong to withstand a much greater strain than she would ever encounter in the waves of the Atlantic.

The design would admit of the different sections conforming to the angle or elevation of any size of waves she would meet without straining.

One of the important advantages that a steamer of the proposed plan and proportions would have is the immunity from the horrors of seasickness that the passengers would enjoy, as there would be scarcely any rolling motion, and the vertical motion would be confined chiefly to the forward ends of the forward sections and would diminish toward the stern, where it would hardly be perceptible even in the roughest sea, as the forward sections would break the force and form of the waves they would pass over.

The steel floats on the outside might retard the speed a knot or two, but they are not a necessary part of the plan and may be detached. They furnish berths for four or five hundred of the crew, also help to steady the outer trains, and would be useful for collision fenders.

It is proposed to use paddle wheels for the propelling medium. Of course, 3, 4 or 5 screws could be used at the stern, but would not be so suitable for the high speed as the paddles, which, working in protected water, and having a diameter of 56 feet, with engines to drive them at 35 revolutions, should make about 35 knots.

To many no doubt it may seem impossible to control the motion of such heavy structures in a seaway. As a matter of fact there is only one motion in a seaway that is not preventable, and that is the vertical motion, which it is not necessary to control.

The system of connection (as shown in the smaller view) allows playroom for that to a much greater extent than is necessary. The tendency, however, in a steamer of this design would be to lessen it. It is the lateral motion that could be easily diminished or prevented.

The proposed steamer would have accommodation for 4,000 passengers, giving a greater number of cubic feet for each passenger than the present steamers, and, as it would carry no freight, would remain a shorter time in port. So that at the speed that would be attained she would average about one trip a week, or forty during a season of nine months. Carrying 160,000 passengers at present rates for corresponding class of accommodation, 80,000 first class would pay $6,400,000; 80,000 second class, $3,200,000; total, $9,600,000; which ought to pay a very handsome dividend after paying operating expenses of one steamer.

It will be seen from the above figures that such a steamer as has been described could earn immense profits at one-half the present rates.

A $5,000,000 hotel with accommodation for 1,000 guests at $5 per day would pay well. There is no reason why a steamship (costing $8,000,000 with room for 4,000) should not pay better at the same rates.

There are several reasons why cargo and passengers should be carried in separate vessels, and among them is the fact that it does not pay to carry cargo in a high priced passenger boat. A special cargo steamer (like a "whaleback," for example) can be built at a cost of $200,000 that will carry more cargo than the Majestic, that cost $2,000,000. But these steamers do not carry cargo for the money there is in it, but because they must have several thousand tons of cargo or ballast in their holds to give them the necessary stability and draught for effective working of screw. As the new design would require no ballast, she would run much lighter.

Natural History Notes.

Oysters and Mussels as Water Filters.—It has been observed that sea water, which always holds solid particles in suspension, becomes clear with surprising rapidity when an oyster or a mussel is placed in a vessel that contains it. These animals, in fact, as soon as they are immersed in their natural element, establish a rapid current of water between their separated valves. Of the particles that such current carries along, some are agglutinated into large lumps by a mucous secretion of the mantel and are then immediately rejected, while others traverse the digestive tube to be afterward expelled in the form of solid excrement. It results that after the lapse of a very short time, the mollusk has filtered the surrounding water, but the amount of filtered water is not the same with all oysters and mussels. The researches of Mr. H. Viallanes shows in fact, that mussels, in the same period of time, filter three times as much as the French oyster, and that the Portuguese oyster filters five and a half times as much.

From the standpoint of oyster culture, these results explain the cause of that dying off of oysters that culturists have been complaining of for some years, and indicate the remedy for it, that is, the suppression of the mussels and the proscription of Portuguese oysters from the parks in which the French oysters develop.

Mr. Vaillanes' researches permit also of comprehending the importance of the role that these mollusks have played and are still playing in the economy of the seas and the building up of the continents. These animals, which endure changes of saltness better than others, constitute colonies that are often immense and elevated as barriers at the confines of marine and fluvial waters. They are powerful filters charged with freeing the latter of the solid materials that they are carrying to the ocean.

Self-Mutilation in Orthoptera.—It has often been observed that many animals, when kept in captivity, develop certain unnatural traits. One of these is a tendency to self-mutilation—an instinct on the part of the animal which impels it to devour the extremities of its own body.

Dr. Franz Werner, of Vienna, Austria, has recently published some interesting observations in this direction on European orthoptera. From a number of species kept under observation Dr. Werner concludes that a tendency to self-mutilation does not prevail in the truly phytophagous families, such as the Acridiidæ and Gryllidæ, but that it seems to be confined to the raptatorial species and that it is most strongly developed in certain predaceous Locustidæ with poorly developed wings. In all observations ample nourishment was provided, but this did not prevent the specimens from eating first their tarsi, especially those of the anterior pairs of legs, then the tibiæ, and finally the females commenced to eat their own ovipositors. Among the species observed the rare *Saga serrata* excelled all others in its avidity to devour its entire legs, while *Mantis religiosa* was contented with chewing up its tarsal joints. Of *Barbitistes serricauda* Dr. Werner was not able to collect perfect examples, for as soon as a captured specimen is held between the fingers it bites off its own front legs with great rapidity. In most instances the chewing is deliberate and evidently without sensation of pain.—*Insect Life.*

The Giant Birds of New Zealand.—The discovery of the *Dinornis* by the illustrious zoologist Richard Owen is famous as one of the most notable feats in the history of science. From a single imperfect bone—a femur broken at both ends—he deduced the fact that an enormous bird of the struthious order, but far exceeding the ostrich in size, formerly inhabited New Zealand. This discovery, published in 1839, aroused much interest and led to further inquiry. Four years later, Mr. Owen was able to show, from a comparison of many fragments of skeletons that had reached him, that there had been at least six species of these gigantic birds. With additional materials, he, in 1850, had increased the number of species to eleven, classed in three genera, and varying in size from a kind no larger than the great bustard (or about five feet high) to one —the *Diornis giganteus*—at least ten feet in height. Stilllater researches have shown that even this stature was in some instances surpassed, and that birds must have existed in New Zealand whose height attained fourteen feet, or twice that of the largest ostrich.

The Succession of Teeth in the Mammalia.—It is a familiar fact that, whereas nearly all the lower vertebrates—fishes, batrachians, and reptiles—have an almost unlimited power of reproducing their teeth as occasion requires, the higher vertebrates, or mammals, are never provided with more than one change of teeth during their lifetime It has also been for a long time well ascertained, that the lower mammals (Marsupialia) as a rule exhibit even less change of teeth than the higher (or placental) mammals. There has thus been great difficulty hitherto in explaining the manner in which the mammalian type of dentition became evolved from the primitive constantly reproduced type such as we observe, for instance, in the crocodiles. Numerous theories have been proposed to account for the apparent anomaly that the lower mammals exhibit less tooth change than the higher mammals, while, contrary to the teaching of the great pioneers in comparative anatomy, such as Cuvier and Owen, the majority of the modern school has long held the belief that mammals originally possessed but one set of teeth and gradually acquired the power of reproducing part of this set once in a lifetime.

The remarkable investigations of Dr. Willy Kukenthal have now afforded a definite solution of the problem. It appears from an examination of some embryos of opossums that the replacing set of teeth is actually present in the jaw, although only one of these teeth ever completely develops and becomes functional. It is also proved from a study of the embryos of certain armadillos and toothed whales in which no tooth replacement has been observed, that the replacing set is actually formed though absorbed without use in the adult. In short, we may definitely conclude that mammals originally inherited two sets of teeth from their cold-blooded ancestry, that in some groups, such as the toothed whales, some armadillos, and marsupials, the second set of teeth is almost or quite aborted, while in the majority of the higher mammals this set is functional and partly replaces the first set. As a matter of fact, the two series of teeth in the jaw of the embryo always originate by the division of a single series of germs, and in this respect the mammalian dentition presents some difference from that of the reptiles and batrachians. There are, moreover, other points still awaiting elucidation, as remarked in a critical article by Mr. Oldfield Thomas in the *Annals and Magazine of Natural History.*

Paleontology as usual may be expected sooner or later to assist in the solution of the remaining difficulties, and it is interesting to notice in the May number of the *American Journal of Science* that Professor Marsh has already a small contribution to the subject. In describing the primitive Eocene mammals, *Hyracops* and *Meniscotherium*, the professor remarks that the replaceable first set of teeth remains in use long after the appearance of the three permanent molars, thus suggesting that the latter are actually a retarded portion of this first set, and not part of the second series.

Lender's Paint.

The paint it is stated preserves metals from rust and is unaffected either by heat or cold. When applied to sheet iron it was found that the coating was unaffected by warm water or steam, and also to be unaffected by the action of acid and alkaline liquids, ammonia gas, hydrochloric acid gas, and sulphureted hydrogen gas. The principal ingredient in this paint is a silicate of iron which is found in the neighborhood of natural deposits of iron ores, and also occurs in veins, in deposits of granite, which have become decomposed by contact with the air. This deposit, which is employed in the form of a finely ground powder, is found to have the following composition:

Silicic acid	5·4
Phosphoric acid	0·5
Oxide of iron	88·65
Alumina	0·5
Lime	1·75
Magnesia	1·35
Undetermined	2·3
	100·00

The silicate of iron in a very finely divided state is mixed with oxidized linseed oil, and varnish, to form a paste. When required in the form of paint, it is thinned down with good linseed oil, to which, if deemed desirable, a drier, such as litharge, is added, at the same time mineral colors to produce the required shade are likewise added.

Artificial India Rubber.

Dr. W. A. Tilden discovered some months ago that isoprene, which can be prepared from turpentine, under certain circumstances changes into what appears to be genuine India rubber. Bouchardat had also found that the same change could be brought about by heat. The material so produced resembles pure Para rubber in every way, and, whether it is genuine rubber or not, it may be equally good for all practical purposes. It is said to be capable of vulcanization.

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WHY ARE STEREOSCOPIC PRINTS TRANSPOSED?

Mr. Emil Kurtz asks this question of the SCIENTIFIC AMERICAN. This problem, although very simple, is somewhat puzzling. The stereoscopic prints are transposed to bring them into the position the object occupies when seen with the eyes. The two pictures numbered 1 and 2 represent the view as seen with the two eyes, the one marked "L" showing the view as it appears to the left eye, and the one marked "R" showing the view as it appears to the right eye. Each tube of the stereoscopic camera inverts its own view; therefore, when these pictures are turned a half revolution in their own planes, as shown in the second engraving, they represent the image formed in the camera, and consequently the negative as seen from the glass side, also the print from the negative.

By placing this double picture right side up, it will be seen that the images have been transposed in the camera in being inverted, and, as the letters L and R now adjoin each other, the left hand view appears in front of the right eye, while the right hand view appears in front of the left eye, as shown in Fig. 2. It is, therefore, obvious that to place these two pictures in position to correctly represent the views as seen by the eyes, they must be cut apart and transposed, when they will appear as in the first engraving.

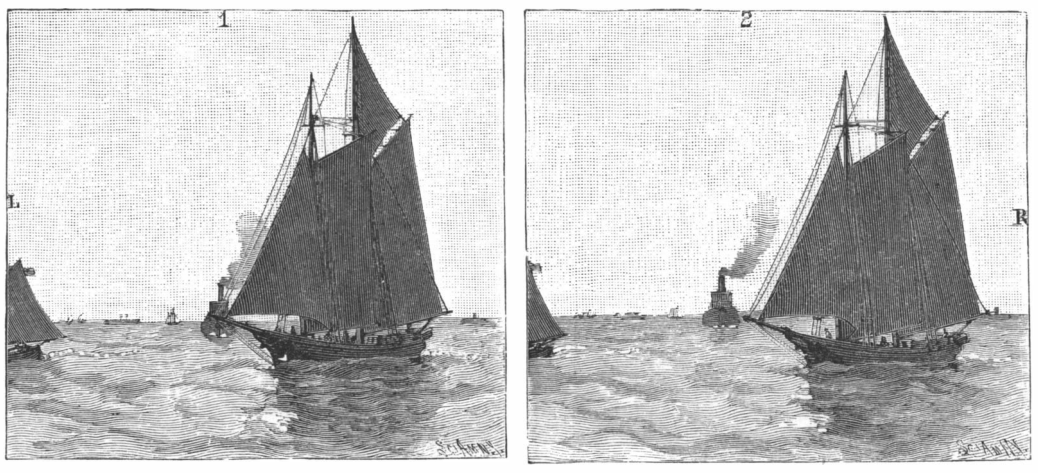

Fig. 1.—THE VIEW AS SEEN BY THE EYES.

The Heating of Cars by Steam.

A paper on this subject was read lately at the meeting of the Western Railway Club, by Mr. A. M. Waitt, assistant master car builder of the Lake Shore and Michigan Southern. The author believes that for some years to come steam is destined to be the working medium for car heating.

On the railroad with which the writer is connected we have had in use in coaches both the direct and indirect systems of heating, and with the indirect have tried four different kinds. We have had weekly, and sometimes daily, complaints of freezing traps, lack of circulation, cold cars, burst pipes, etc.; while from the direct system generally only one complaint has been heard, that of occasionally too much heat in mild weather. The result of the above experience, after three or four years' repetition, has been to cause the adoption by the Lake Shore and Michigan Southern R.R. of the direct system for all coaches, baggage and mail cars.

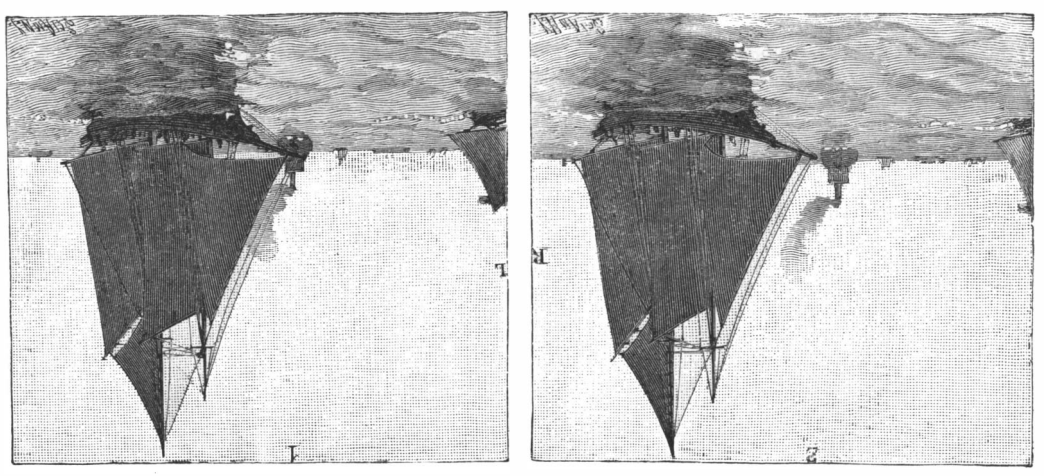

Fig. 2.—THE INVERTED IMAGES AS THEY APPEAR IN THE CAMERA AND NEGATIVE.

On sleepers the experiment has been tried with both systems of heating, resulting in the almost immediate abandonment of the direct system; for, when the berths were made up for the night and circulation of air was arrested behind the curtains, the heat became too oppressive for sleeping; and the porters were too apt to neglect the regulation of the heat, if, indeed, it were possible to properly regulate it. This result, of course, left the indirect system alone in the field for this class of cars. As there were many indirect systems proposed and used, it became a study to see which was the best, and to remedy, as far as possible, all existing defects.

It must be said of the writer's experience with indirect steam in sleepers on the rear end of from twelve to fourteen car trains, that in zero weather the complaints of cold cars, with temperature not above 60 deg., were very numerous, and this, with a pressure from the locomotive of 80 lb. It has also been found in such cars in zero weather that with cars cool when leaving a division terminal, and from 2 to 10 lb. of steam on the gauge, it would take from one to three hours before a temperature of 70 deg. was reached, and in many cases but little rise in temperature was obtained even in that time.

Taking up separately the different parts of steam heating apparatus, Mr. Waitt said that for the train pipe the general practice was to use 1½ in. pipe well covered with asbestos lagging. He saw no advantages in carrying the train pipe overhead as practiced on a few roads. For connections a flexible wire-bound rubber connection is cheaper and freer from leakage than any flexible metallic connection. A well made rubber hose, five-ply, wire-bound, made of not pure rubber, will stand at least one season's service without failure, and such hose is now made and guaranteed for such a time. It can also be said truthfully that there are in the market steam couplers, free from leaking, simple in manipulation, and highly satisfactory, that have now successfully stood the test for years.

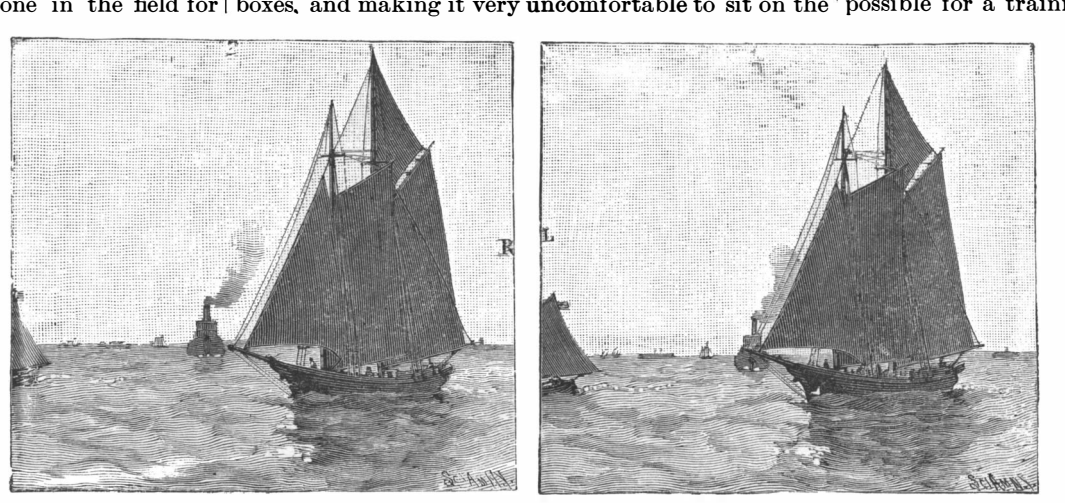

Fig. 3.—TRANSPOSED PRINTS.

Inside the car the method of controlling the steam by a single three-way valve near the middle of the car is preferable to two single valves on each side of the branch pipe or two cocks in the train pipe at each end of the car under the platform. The three-way valve is simpler to understand and manipulate, is less work to apply, and is less liable to collect condensation and freeze. The cocks under the platform are objectionable, because the cocks can only be opened or closed when the car is standing still. The three-way valve should have the water from the drip pass in contact with it to prevent the drip from freezing. We quote further as follows:

When the use of direct steam for car heating was first adopted, there was a fear of insufficient heating, and a mistake was made by the use of altogether too much radiating pipe. One of the first plans consisted of two lengths of 2 in. pipe on each side of the car, and in addition a spur of 2 in. pipe from 12 to 30 in. long under each seat. This resulted in putting steam heating into bad repute by making cars perfect sweat boxes, and making it very uncomfortable to sit on the cushions with a hot steam pipe directly under the entire length of each one. Gradually the use of spurs and return bends has been curtailed, until now the most approved arrangement consists of two lines of 2 in. pipe on each side of the car, without any spurs or radiators under the seat. In some cases it has been deemed best to use 1½ in. pipe, and in addition a short 10 in. spur under alternate seats.

With the indirect system of heating, experience has shown that there has been a lack of the requisite radiating surface, and it is being gradually increased. The prevailing practice has been to use 1¼ in. pipe, and the same amount of it as with the simple Baker heater. In the writer's opinion much better results would be obtained in long cars by using not less than 1½ in. pipe, thereby allowing freer circulation and increasing considerably the radiating surface.

The radiating pipes on each side of the car in the direct system should, for proper regulation of heat and adjustment, have a separate steam controlling valve and a drip valve, also a separate pressure gauge.

Steam Admission Valves.—In this feature of steam heating lies much of the secret of successful results in the direct system of car heating. Most cars at present are equipped with an ordinary cheap globe valve to control the admission of steam to the radiating pipes. With such valves in good order, if the valve is just started from its seat by a small fraction of a turn of the spindle, there is an opening made for the steam admission as large, if not larger, than the supply opening from the locomotive boiler. This admission of steam is enough to keep the car well heated in freezing weather, after it has once been warmed up. If the weather is mild, and only enough heat wanted to take the chill off the air, it is impossible to graduate the valve sufficiently fine, but an approximate result must be obtained by alternate turning on and shutting off the steam, which, of course, results in great dissatisfaction.

Another difficulty with the common globe valve for an admission valve arises from the fact that it can be kept in order but a short time. After a few months' use they become so warped that few of them can be closed absolutely tight, and many times it becomes impossible to cool the cars off, except by shutting steam out of the car at the three-way valve. To overcome these difficulties, and to put it within the power of a reasonably intelligent trainman to regulate the amount of admission of steam to the amount passing through an aperture of 1-100 in. in diameter if desired, a committee was some months ago appointed by the heads of the mechanical departments of some of the Vanderbilt lines, to prepare specifications for a suitable valve. The result has been that two reputable companies are now prepared to furnish at a reasonable figure a valve having all parts subject to wear renewable at small cost, leaving the shell of the valve intact; the valve is capable of an adjustment such that one full revolution of the spindle will give an area of opening of only about 1-100 in., the valve being capable of opening to full area of a 1 in. pipe. The valves are so constructed as to be especially free from cutting out by wire drawing of steam. With a durable valve of this kind it becomes possible for a trainman to be able to readily regulate the admission of steam to so small an amount that it will not even heat the entire length of pipe in the car, and, with properly instructed trainmen, good results can be obtained.

Traps.—If the inspectors and trainmen on our roads are carefully questioned, it will be found that traps are a source of constant trouble, sometimes from freezing up or choking with water, and sometimes from allowing too much steam to waste. Of all the traps examined by the writer, after they have been in practical operation for any great length of time, none have been found but what need constant readjustment to suit any material changes of outside temperature. It often happens that on starting on a long run a trap may be all right for the present temperature, but after a 400 or 500 mile run the thermometer stands 20 or 30 deg. lower; under these circumstances, many traps become choked with water and frozen, causing delays for thawing out and readjusting.

In view of these facts, many companies have abandoned the use of traps, and have substituted a much more satisfactory method of caring for the condensa-

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tion, namely, the use of a globe valve at the end of the radiating pipes on each side of the cars. In some cases it has been deemed wise to file a small groove in the valve seat, so that it can never be entirely closed. Such a groove is intended to be large enough to take care of all condensation in mild weather, and in cold weather the trainmen are expected to adjust the opening of the drip valve to suit the amount of condensation. By others it has been thought best to leave the drip valve intact, and to allow trainmen to regulate it for all conditions. This arrangement permits of allowing the condensation in mild weather to partially fill the radiating pipes, and the heat can be then controlled by the amount of condensation allowed to pass off. It can be readily seen that by this arrangement, if half the pipes were filled with water, the steam would only reach and heat the other half of the pipes.

With the present state of invention in relation to traps, I think the plain drip valves have decided advantages. In this connection I would recommend that, where possible, the steam admission and drip pipes should be kept in contact, and covered in the same jacket, and the outlet of the drip be in contact with the three-way valve, or pass through it as is arranged for in one style of three-way valve now on the market.

It may be of interest to know that since last spring a committee, representing several of the Vanderbilt roads have had in hand an investigation of the matter of steam heating for cars, and a summary of the results of their work is contained in the following recommendations for adoption:

1. That the "direct" system of steam heating be used for heating coaches.

2. That the "indirect" system of steam heating be used in sleeping cars.

3. That in the "indirect" system, salt water or a non-freezing mixture be used in the circulating pipes.

4. That a three-way valve be uniformly used for controlling the steam in the main train pipe, the parts located inside the car to be uniform, the valve to take a solid (male) wrench, and the marking on the floor plate to be uniform, and to indicate the direction of the main train pipe and the branch supply pipe, and to be similar in size and style to the Martin floor plates, now in general use on the roads represented.

5. That we approve and adopt for general use the style of steam controlling valves as designed and made for our committee by Fairbanks & Co., of Boston, and by the Safety Car Heating and Lighting Co., of New York.

6. That the use of traps for taking care of the drip be dispensed with.

7. That we use a globe valve for the drip valve, with a small slot filed in the seat of the valve, so it can never be entirely shut off.

8. That two lengths of 2 in. pipe on each side of the car with no spurs under the seats are sufficient for satisfactory heating.

9. That for "indirect" heating, all pipes and connections, except train pipe, shall be maintained inside the car. That the system be limited to one steam valve and one drip valve, placed uniformly in all cars.

10. That at all terminal and junction points, where passenger trains are made up, or cars are likely to be set off, facilities be provided for heating cars by steam, when not in trains. This we consider very essential to the successful heating of cars by steam.

Sea Sickness.

Most of those who have experienced the miseries of sea sickness, however they might differ in minor details of statement, would agree in ascribing this most dispiriting malady to one main cause—the motion of the ship. In so far the whole medical faculty would concur in their decision. This, then, is the central fact which confers upon the disorder its unique position. It is really not a pathological, but a physiological disturbance. It has no natural connection with dyspepsia. The robust and healthy, by a strange contradiction, suffer from it for the time hardly less than the weak and ill. Its variations of intensity are felt to be counterparts of mere bodily oscillation. Some find relief from it in change of posture, others in active occupation, all more or less when their storm-tossed vessel sails under the lee of land. Custom and use commonly secure immunity. These are circumstances which one and all point to mechanical causation as the source of the discomfort. It is the unaccustomed rise and fall, the jerk and relaxation of loosely attached abdominal viscera, mainly, perhaps, but not alone, of the stomach, acting upon the central nervous connections, which must bear the brunt of accusation. It follows that successful treatment cannot be guaranteed by any one method or panacea. Recumbency, pure deck air, moderately firm bandaging of the body, are all useful. Drugs have their place and their partial utility; but, as we have already suggested, there is no remedy equal to a lee shore. Nothing can be much more depressing than sea sickness, and for this reason we should strongly advise all weak persons not to encounter if possible the risk of its occurrence. It is astonishing how soon and how completely those who are favored with a fair measure of constitutional elasticity recover from its depression. In their case the benefits of a sea trip may thus, with compensations of air, diet and appetite, be even enhanced by a few hours of mechanical nausea. It is, in truth, for such persons only that tours of this kind are advisable.—*Lancet.*

The Fastest Steam Launch.

The steam launch Yankee Doodle, probably the fastest boat of its class in the world, was unfortunately destroyed by fire, at Philadelphia, in September last. The boat was originally called the Buzz, built by Mosher, of Amesbury, Mass., but as her speed did not prove satisfactory her original boiler and wheel were removed and new ones substituted by her new owners, Messrs. McBride Brothers, of Philadelphia, Pa. The new boiler was quite remarkable. It had 410 one inch steel tubes, tested to 1,900 pounds to the square inch hydrostatic pressure; 360 feet tubular heating surface; weight, 2,000 pounds; grate surface, 8 feet; steam dome, a peculiar feature, 2 by 4 feet; usual boiler pressure, 150 pounds.

Screw, 34 inches, 5 feet 10 inch pitch; two blades; 550 revolutions per minute.

Engine, 160 horse power; two 8 by 8 inch cylinders.

The hull was 50 feet long, 6½ feet beam; displacement, 4 tons; draught, 15 inches.

Her speediest record was made on the fourth of July last, when, according to the report of the official timers, Messrs. G. S. Carrigan, Dr. G. F. Root, and H. E. McPerson, she ran a mile on the Schuylkill River, on the National Course, in 2 minutes 1⅘ seconds—almost thirty miles an hour. The timers were not on the boat, and their record is believed to be reliable. We understand the Messrs. McBride intend, during the coming year, to build another boat equal or superior in speed.

CREOSOTED wood has been found to have such excellent lasting qualities that its economical properties have suggested its use for permanent haulage, roads, shaftways, etc., in collieries.

RECENTLY PATENTED INVENTIONS.

Engineering.

HYDRAULIC PROPELLER.—John T. Carstairs, Wellington, Canada. Two cylinders containing pistons are, according to this invention, operated simultaneously to alternately draw in and discharge water from either the stern or bow of a vessel, thus propelling it forward or backward as desired. A set of pipes also leads from the gate boxes connected with the cylinders to each side of the vessel, whereby the vessel may be steered by manipulating the gates in the boxes.

Mechanical.

LATHE DOG.—Richmond Parsons, Philadelphia, Pa. This dog is made in two parts, the body part being of U-shape, with teeth on its inner faces, and the bridge piece being adapted to be passed laterally into and out of the body. It can be readily adjusted to different sized work, and applied without removing the centers of the work from the lathe, a clamping screw firmly holding the work after adjustment.

MACHINE FOR NAPPING CLOTH.—George W. Burr and Michael Malony, Webster, Mass. This machine is especially designed for use with the ordinary shearing machine to raise the nap on woolen or worsted goods, and consists of an attachment having oppositely rotating napping cylinders, with needles to raise the nap both ways at the same time, in connection with a tension device to regulate the pressure of the cloth upon the cylinders. The invention also covers a novel construction of the cylinder needles.

SCREW DRIVER.—William E. Daily, Morristown, Tenn. This invention provides a tool of which the bit may be revolved, and the screw forced to place or withdrawn, by means of a crank handle and gearing. The construction is such that the bit may be held to turn only with the shank of the screw driver, of which it constitutes a fixture, while one of the bits may be used with large screws and its other end with smaller ones.

COUPLING.—Irvin P. Doolittle, Redlands, Cal. A means for speedily and firmly connecting sections of pipes, hose, or solid rods, at their ends, and so they may be detached as desired, is provided by this invention. A spiral cam-locking lever is pivoted in a slot on a female coupling section, and has an adjustable interlocking connection, with a channel shoulder on a male coupling section. By means of a joint washer an air tight or water-tight joint is made between the joined coupling sections.

Miscellaneous.

GUN CLEANER.—Charles W. Wunderlich, Washington, Mo. This device has a stock portion with internally threaded socket, forwardly extending spring arms being connected to the peripheral face of the stock, their forward ends contracted and bent to form radial scraper fingers, while a conical expander, having a threaded shank, operates in the threaded socket of the stock. In use the cleaner is attached to the ramrod of a gun, in the chamber of which it is moved back and forth. Its construction is such that, if any of the parts be broken or injured, they may be readily repaired or replaced.

WATCHMAKER'S TOOL.—Charles Smith, Mount Carmel, Ill. This invention relates particularly to a holder for the movement while securing the hands to the center post, providing a solid anvil support for the post, by means of which the hands can be securely riveted thereto without danger of breaking the center jewel. Means are also provided for holding movements of various sizes by using readily attachable and detachable spacing rings in the box or case.

CONSTRUCTION OF BUREAUS, ETC.—Edward P. Lurker, Evansville, Ind. This invention provides a manner of constructing bureaus, dressing cases, chiffoniers, etc., with sliding drawers, in such a way that the entire article may be finished at one handling, the goods being thus turned out rapidly and the manufacture requiring but little room. With this construction the parting rails are adjustable vertically and laterally, and may be adjusted to the drawers when the bureau is built, to insure a perfect fit, the bottom being attached after the drawers are fitted, and being adjustable up or down.

CUFF BUTTON AND FASTENER.—James F. Poage, Kirksville, Mo. This device has a long flat shank on one end of which the button is held and made integral with the shank, while on the other end are pivoted jaws and a clasp, to secure firm attachment to the sleeve, whereby the cuff may be held in the exact position required, and an expensive cuff button may be used without danger of losing it.

ENVELOPE.—Hugo Roberts y Fernandez, Havana, Cuba. This envelope is made of but one piece of paper, the blank being so formed that glue or cement is not needed in fastening the parts together, but when the parts are united the envelope cannot be opened without tearing some of the parts. The bottom and end flaps each have slots which register when the blank is folded, while the top flap has a cruciform tongue, the vertical member of which passes through the three pairs of slots, the transverse member being wider than the slots, and being folded to pass through an upper slot, then unfolded to prevent withdrawal.

FISHWAY.—William H. Rogers, Amherst, Canada. This invention covers an improvement on a former patented invention of the same inventor, the fishway being so constructed that it may be built below the dam and inclosed in a strong cribwork, securing an entrance for the fish close to the dam, at a point where they will readily find the opening. The upper flume and upper end of the fishway leading into it are constructed to extend any desired distance above the dam, the flume and upper fishway being protected from ice and floods by a suitable covering. The fishway or channels may be applied to a perpendicular dam or one with considerable batter, the whole structure being firmly anchored to the dam, and the entire lower portion of the cribwork being ordinarily loaded down with stone ballast.

WAGON BRAKE.—Vardiman T. Sweeney, Springfield, Ky. A brake mechanism by which the brake may be applied directly and positively to both the front and the rear wheels of a vehicle, or to the rear wheels only by simply backing the team, is provided by this invention. The device may also be so operated that the team may be backed without applying the brakes, this result being effected by a shifting device in ready reach of the driver. The construction is very simple, and this brake may be readily applied to any form of running gear.

PHOTOGRAPHIC DARK CHAMBER.—Isaac Bryner, Callaway, Neb. A box containing collapsible parts of a dark room is formed of a base board, hinged side boards and top pieces, with end pieces, the inner surface of the side pieces having attached receptacles to receive and hold bottles with chemicals for developing and treating the negatives, while a plate-holding box is held in place by a spring. A compact and simple portable dark room is thus formed for photographic work, one which may be quickly set up and readily taken down and packed in small compass for transportation.

CURTAIN STRETCHER AND CLOTHES HORSE.—Edward N. Kenworthy, Oldham, England. This is a combination device comprising standards adjustably secured to a top bar, with two stretcher bars on opposite sides of the standards. The structure is readily adjustable to various sizes and patterns of curtains, facilitating their stretching and drying, and enabling the curtains to be secured without the use of permanent pins or hooks, while it may also be used as a clothes rack or clothes horse, or to support draught screens or screens for use in magic lantern lectures.

LACE FASTENER.—Justus W. King, Helena, Mont. This is a device adapted for attachment to a corset, to shoes, or any article in connection with which a lace is employed, automatically locking and holding any portion of a lace brought in engagement with it, and being also capable of adjustment to laces of different thicknesses. The device consists of a circular base of thin metal with a central depressed surface, loosely carrying a spring-controlled locking button, the frictional engagement between the cylindric portion of the base, the lace and the button effectually preventing the lace from slipping.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

SCIENTIFIC AMERICAN BUILDING EDITION.

OCTOBER NUMBER.—(No. 84.)

TABLE OF CONTENTS.

1. Elegant plate in colors, showing a handsome residence at Belle Haven Park, Greenwich, Conn., recently erected at a cost of $18,000 complete. Floor plans and two perspective elevations. Messrs. Lamb & Rich, architects, New York.
2. Plate in colors showing an elegant residence at Montclair, N. J. Perspective view and floor plans. Cost $7,000 complete. Mr. E. T. Hapgood, architect, New York. An excellent design.
3. A house at Montclair, N. J. Two perspective views and floor plans. Cost $4,750 complete. E. T. Hapgood, architect, New York.
4. A Queen Anne cottage recently erected on Chester Hill, Mount Vernon, N. Y., at a cost of $5,000. Floor plans, perspective elevation, etc.
5. A house for two families erected on Armory Hill at Springfield, Mass., at a cost of $7,000 complete. Mr. F. R. Richmond, architect, Springfield, Mass. An excellent design. Floor plans and perspective.
6. A model dwelling at Holyoke, Mass. A unique design. Perspective elevation and floor plans.
7. A small cottage and separate summer kitchen. Perspective views and floor plan. Cost for both buildings, about $1,600.
8. The parsonage at Montclair, N. J., built for the Congregational Church. Cost complete $15,000. J. C. Cady & Co., architects, New York. Perspective view and floor plans.
9. A handsome residence at South Orange, N. J. Floor plans and perspective elevation.
10. A cottage at Fanwood, N. J., erected at a cost of $5,166 complete. Perspective elevation and floor plans.
11. Portal of the church of Moret-sur-Loing, France.
12. Illustrations of two handsome English country houses.
13. Miscellaneous contents: The coming age of marble.—White brick.—How to keep out the heat in summer and to keep it in in the winter.—House moving.—Tempering tools.—Closet door fastenings.—A right-of-way may be built over.—Stanley plumbs and levels, illustrated.—Safety crane, illustrated.—An improved range and heater, illustrated.—Railway window sashes.—A great tunnel.—Inside sliding blinds, illustrated.—About floors.—A fine steel ceiling, illustrated.—An improved door hanger, illustrated.

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References to former articles or answers should give date of paper and page or number of question.

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Minerals sent for examination should be distinctly marked or labeled.

(4581) W. P. C. asks (1) what the Harden hand grenade for extinguishing fires are made of. A. Hand grenades for extinguishing fires are made by filling thin spherical glass bottles with a solution of calcium chloride, salammoniac or borax. 2. A good insulating material that I can mould out for insulating storage battery plates. A. Use gutta percha. 3. Are there any two acids mixed together that will cause an explosion? A. Yes. 4. Will sulphuric acid set fire to wood? A. Sulphuric acid will char wood by extracting the elements of water. 5. Will the spray from the storage batteries set fire to wood? A. We do not think it would set fire to wood.

(4582) O. S. asks: What is the chemical agency of ammonium chloride in the microphone battery? A. The reaction is supposed to be as follows:

$$2\,NH_4Cl + 2MnO_2 + Zn = ZnCl_2 + 2NH_3 + H_2O + Mn_2O_3$$

The ammonium chloride acts on the metallic zinc, forming zinc chloride and liberating ammonia.

NEW BOOKS AND PUBLICATIONS.

THE STANDARD ELECTRICAL DICTIONARY. A popular dictionary of words and terms used in the practice of electric engineering. By T. O'Conor Sloane, A.M., E.M., Ph.D. New York: N. W. Henley & Co. 1892. 12mo. Pp. 624. Cloth. Price $3.

In the Standard Electrical Dictionary we have an important addition to the working library of the amateur and professional electrician. The definitions are illustrated whenever necessary by well executed illustrations, which number in all over three hundred. The work has a very complete index, which renders the use of cross references unnecessary. The author has evidently done his work in a very thorough manner. Take Electricity for example. Here the author has modestly given no definition of his own, but he does not hesitate to give the opinions of seventeen of the best authorities, including many of the foremost electricians of the world. Many words are given which, owing to the rapid strides of electrical science, are here defined for the first time. There is a clearness in the definitions which recommends the book particularly to the beginner, while the advanced electrician will find such subjects as the theory of dimensions and the dimensions of electrical units fully treated. The work is an invaluable addition to even the smallest of electrical libraries.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

October 25, 1892,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Air cooler, return, H. B. Roelker ... 484,979
Air or gas meter, F. E. Youngs ... 485,075, 485,076
Alarm. See Burglar alarm
Alcohol from liquor casks, apparatus for and method of recovering waste, M. Hickey ... 484,963
Animal trap, M. Johnston ... 484,799
Antifriction clasp, W. L. Black ... 484,947
Baby tender and crib, combined, A. Baird ... 485,081
Bag. See Nursery bag.
Baker's and confectioner's depositing apparatus, R. Megson ... 484,937
Baling press, C. E. Whitman ... 485,072
Baling press feeder, Kruse & Shipley ... 485,045
Batteries, finishing grids for secondary, A. F. Madden ... 485,128
Batteries, standard cell for electric, H. S. Carhart ... 485,089
Battery. See Secondary battery.
Bearing, machinery, J. D. Brown ... 484,993
Bearing, roller, S. B. Bartlett ... 485,083
Bed bottom, L. Hinkle ... 484,912
Beer, treating, A. Kreusler ... 485,012
Belt, link, D. S. Stewart ... 484,827
Berry picker, C. C. Read ... 485,057
Bicycle, Dey & Griswold ... 485,094
Bicycle, A. H. Kempe ... 484,857
Bicycle brake, R. C. Fay ... 484,953
Bicycle support, J. J. Muller ... 484,941
Bill holder, S. F. Woody ... 484,904
Bin. See Flour bin.
Bit. See Bridle bit.
Blind, inside window, J. W. T. Gilliam ... 484,957
Block. See Ceiling block. Differential block.
Board. See Game board.
Boiler, J. Cahall ... 485,087, 485,088
Boiler flue protector, steam, H. H. Nieman ... 485,112
Boiler setting, M. F. Eaton ... 484,878
Boiler tube cutter, J. W. Fleming ... 484,852
Boilers, expanding device for use in making wash, Anderson & Huntington ... 485,078
Book-back, folding, W. H. Sugg ... 485,068
Book, duplicating check, J. Oldfield ... 485,132
Bottle closure, C. Ollendorff ... 485,052
Bottle, nursing, O. K. Newell ... 484,811
Bottle stopper, J. De Mars ... 485,093
Bottle stopper, B. F. Sanborn ... 485,139
Box. See Core box. Egg box. Hat box. Letter box.
Box strap, metal, S. C. Cary ... 485,150
Brake. See Bicycle brake. Car brake.
Brake handle, Fosburgh & Milligan ... 484,954
Brake shoes, art of and apparatus for making, C. T. Schoen ... 484,866
Brick and tile machine, J. J. Kulage ... 484,897
Brick press, J. J. Kulage ... 484,896
Bridges, expansion bearing for, G. S. Morison ... 484,971
Bridle bit, L. F. Brown ... 484,994
Buckets, automatic latch opener for, C. P. Dole ... 484,782
Buckle, G. La Chapelle ... 485,104
Bureau, N. H. Clark ... 484,948
Burglar alarm, F. A. Goelze ... 485,101
Butter from milk, separating, C. G. P. De Laval ... 484,916
Butter package, C. L. Kneeland ... 485,011
Button, H. M. Nester ... 485,111
Button, A. E. Newcomb ... 484,810
Button cutting machines, etc., tool holder for, F. E. Beckwith, Jr ... 485,147
Button fastening, E. A. Giles ... 484,853
Button machine, A. Phelps ... 484,976
Button setting machine, A. G. Wilkins ... 484,835
Cable crossing, H. A. Benedict ... 484,772
Calculating machine, F. C. Osborn ... 484,814
Calipers, inside, R. C. Nugent ... 484,813
Can. See Paper can. Shipping can.
Can, C. C. Lockstaedt ... 484,936
Cape and cap, combined, A. T. Aldrich ... 484,945
Car brake, G. R. Elliott ... 484,783
Car brake, F. I. Rego ... 485,135
Car brakes, slack adjuster for, W. H. Marshall ... 484,859, 484,860
Car coupling, W. B. Clark ... 484,997
Car coupling, Johnson & Olander ... 485,042
Car coupling, W. Miggett ... 484,939
Car coupling, H. & B. Oakes ... 484,900
Car coupling, F. T. Russell ... 485,061
Car coupling, A. Schroeder ... 485,062
Car door, S. W. Gross ... 485,007
Car driving mechanism, C. W. Hunt ... 484,914
Car fender or guard, W. W. Baxter ... 484,989
Car heating and ventilating system, J. A. Healy ... 485,036
Car seal, A. P. Travis ... 485,070
Car slack adjuster, W. H. Marshall ... 484,858
Car, sleeping, S. M. Charles ... 485,151
Carbonating liquids, art of and apparatus for, C. A. & J. Schneible ... 484,901
Carburetor, J. Clingman ... 484,949
Card, playing, J. W. Hyatt ... 484,798
Carding engine, W. P. Canning ... 484,928
Carding engine flats, protector for the ends of the clothing of, W. P. Canning ... 484,846
Carriages, lock for the wheels of children's, J. A. Birkholz ... 484,873
Carrier. See Egg carrier. Hose pipe carrier. Thrashing machine straw carrier.
Cartridge crimping machine, M. A. Twitchell ... 484,868
Cash indicator and recorder, G. R. Burt ... 485,086
Cash register and indicator, E. H. Murdock ... 484,917
Cash register and indicator, J. J. Webster ... 484,887
Ceiling block, J. J. Green ... 484,911
Chain making machine, F. F. Ellis ... 484,909
Chocolate, etc., apparatus for automatically compressing, P. Guerin ... 484,790
Cigarette machine, V. H. Bazerque ... 485,146
Cistern cleaning device, E. C. Davis ... 485,092
Clamp. See Rubber dam clamp.
Clasp. See Anti-friction clasp.
Clothes drier, F. P. Hendricks ... 484,931
Coin-controlled machinery, W. H. Dutton ... 484,908
Condenser and feed water heater, C. Grohman ... 485,031
Condenser and purifier, steam, R. W. Dugan ... 485,004
Converter, W. A. Baldwin ... 484,770
Cooler. See Air cooler. Liquid cooler.
Core box, M. A. Mills ... 484,940
Corn husking machine, S. E. Morral *et al.* ... 484,808
Cotton gin, roller, Montague & Pross ... 485,015
Coupling. See Car coupling. Whiffletree coupling. Wire coupling.
Cover for kettles, etc., J. Doty ... 485,095
Cover, kettle, J. Shilling, Jr ... 484,824
Crane, S. S. Babbitt ... 484,870
Crib, folding, J. Perry ... 484,975
Cultivator, W. S. Miller ... 485,108
Cultivator, Perkins & Cronenberg ... 484,815
Cultivator shovel, S. M. Graumlick ... 484,789
Current generators, regulation of alternating, G. Pfannkuche ... 485,054
Curry comb, A. C. Decker ... 484,848, 484,849
Cut-out, automatic, C. E. Sanford ... 484,865
Cutter. See Boiler tube cutter. Meat cutter.
Cycle wheel, R. C. Fay ... 484,952
Damper, W. H. Packham ... 485,053
Decanting bottles, apparatus for, F. Moog ... 485,050
Dental instrument, C. W. Jones ... 485,110
Differential block, H. W. Rusgrove ... 485,115
Digger. See Potato digger.
Diving dress and helmet, A. E. Stove ... 484,885
Door spring and check, J. Wolf ... 484,838
Draught equalizer, C. S. Ruef ... 485,138
Draught equalizer, S. H. Tinsman ... 485,144
Drawing maps and plots of ground, apparatus for, A. Bodding ... 484,905
Drier. See Clothes drier. Garbage drier.
Drying apparatus, H. W. Rappleye ... 484,821
Egg box, D. Neefus, Jr ... 484,863
Egg carrier and holder, C. W. Costellow ... 484,876
Electric converter, L. Gutmann ... 484,959
Electric generator, magneto, S. Evershed ... 484,785
Electric search light, L. Hills ... 484,964
Electrical switch, G. Binswanger ... 485,028
Electrolytic process and apparatus, H. Blackman ... 484,990
Elevator, Hanson & Bergman ... 485,034
Engine. See Rotary engine. Traction engine.
Evaporating apparatus, O. B. Stillman ... 484,831
Evaporator. See Fruit evaporator.
Excavator, H. P. Bennett ... 485,084
Exercising machine, E. Leamy ... 485,047
Feed trough, I. S. Swetland ... 485,022
Feeding salt to animals, device for, T. B. Stephens ... 485,142
Fence, H. J. Beam ... 484,872
Fender. See Car fender.
File and perforating appliance, combined portable bill and letter, J. W. Grantland ... 485,102
Files, means for and method of designating document, G. H. Ball ... 485,025
Filter, W. M. Deutsch ... 484,781
Filter, faucet, G. F. Aishton ... 485,024
Finger ring, L. J. Heintz ... 484,793
Finger rings, machine for marking or stamping, W. H. Peckham ... 484,918
Firearm lock, L. Jonson ... 485,043
Fireplace, gas log, F. E. Backus ... 485,079
Flour bin and sifter, Davis & Harwell ... 484,780
Fly frame stop motion device, W. P. Canning ... 484,776
Fly frames, bottom cone lifting device for, W. P. Canning ... 484,845
Folding machine, S. C. McKinney ... 485,130
Forceps and tractor, combined, E. J. Howe ... 485,039
Forks, apparatus for cleaning, F. Lehmann ... 485,048
Fruit cutting machine, J. Burns ... 484,995
Fruit evaporator, W. C. Gilham ... 484,910
Game apparatus, E. Dungey ... 484,950
Game board, I. L. Conkling ... 485,029
Garbage drier and burner, F. Cain ... 484,774
Garment supporter catch, J. M. Rabitte ... 484,819
Gas generating apparatus, C. W. Isbell ... 485,009
Gas machine, L. J. Phelps ... 485,134
Gate. See Swinging gate.
Generator. See Electric generator. Steam generator.
Glassware, ornamental pressed, J. Haley ... 485,032
Glove and garment fastener, F. E. Hall ... 484,792
Glove fastener, A. G. Mead ... 484,807
Gold and other metals from their ores, separating, G. J. Atkins ... 484,869
Grain binder, E. M. Kellogg ... 485,157
Grater, nutmeg, H. G. Gilbert ... 484,880
Grinding mill, G. Schock ... 484,884
Grinding pan, A. J. Taylor ... 485,069
Grip device for machinery, intermittent, T. J. Reamy ... 485,058
Hammer, power, J. Canning ... 484,775
Handle. See Brake handle.
Hanger. See Pipe hanger.
Harness machine, Steinbach & Shafer ... 485,065
Harrow, W. Sobey ... 485,020
Harrow and pulverizer blade, R. L. Lukens ... 484,969
Harvester discharge mechanism, Stroud & Corey ... 484,923
Hat box, H. J. Newman ... 484,812
Hat rack, A. L. Van Benschoten ... 484,886
Heater. See Portable safety heater. Steam heater.
Heel blank beveling machine, F. E. Wilder ... 484,833
Hinge, spring, J. Wolf ... 484,839
Hoisting device, self-locking, O. Hillerscheid ... 484,932
Holder. See Bill holder. Label holder. Pen holder. Sash holder. Ticket holder.
Hook. See Snap hook.
Horse blanket, E. Chamberlain ... 484,996
Horse boot, C. A. Rahn ... 484,820
Horseshoe nails, machine for making, D. F. Williams ... 484,836
Hose elevating apparatus, A. O. Muhlstein ... 485,129
Hose pipe carrier, J. M. Harper ... 484,961
Hymn indicator, J. H. Buchanan ... 485,122
Ice cutting machine, W. J. Pine ... 485,114
Ice manufacturing apparatus, J. Buckner ... 485,149
Incrustation preventer, W. H. Wilson ... 484,837
Indicator. See Cash indicator. Hymn indicator.
Inhaler, M. S. Woodward ... 484,944
Ink well, W. E. Lewis ... 484,803
Insect trap, W. Amos ... 485,077
Insulator, C. T. Lee ... 485,106
Insulator for electric railway conductors, C. T. Lee ... 485,105
Intrenching tool, M. A. Luther ... 484,806
Invalid's adjustable back-rest, J. Parker ... 484,974
Iron from ore, separating, H. H. Eames ... 484,877
Ironing board cover, M. S. Everett ... 484,951
Ironing machine, L. H. Watson ... 484,925
Jars or vessels, self-fastening rim for, H. Cone ... 484,779
Kettle, steam jacketed, S. H. Emmens ... 484,784
Kneading machine, dough, L. Durand ... 485,096
Knife for cutting the rope used in boring artesian and oil wells, W. A. Lloyd ... 484,804
Knitting machine needle, C. B. M. Sprowles ... 485,021
Knitting machine, warp, G. Buhlmann ... 484,844
Knob attachment, W. A. G. Ashley ... 485,145
Knob attachment Doebler & Bryant ... 485,154
Knob attachment, F. H. Richards ... 485,137
Label holder, E. E. Smith ... 484,902
Lace fastener, shoe, B. F. Lynch ... 484,899
Lamp, incandescent, F. S. Smith ... 484,825
Lamp, self-extinguishing hydrocarbon, S. A. Johnson ... 485,041
Lantern, magic, E. I. S. Hart ... 484,854
Lantern, signal, J. Wall ... 485,071
Leak stopper, W. F. Beart ... 485,121
Letter box, house door, J. H. Wolfsheimer ... 484,985
Light. See Electric search light.
Liquid cooler, H. C. Gardner ... 484,955
Liquids with gases, apparatus for treating, G. Lunge ... 485,126
Locomotive feed apparatus, I. H. Raynor ... 485,056
Log loader, E. J. Fulghum ... 484,788
Loom shedding mechanism, G. W. Stafford ... 484,922
Mash stirrer, G. Schock ... 484,883
Match heading composition, J. Klein ... 485,103
Measuring device, liquid, W. H. Beecher ... 485,026
Meat cutter, Woodruff & Snow ... 484,987, 484,988
Metal strips, apparatus for hardening, Logan & Stevens ... 484,968
Meter. See Air or gas meter.
Mill. See Grinding mill. Rolling mill. Windmill.
Mirror, portable, W. Q. Prewitt ... 484,818
Miter cutting machine, D. H. Brenner ... 484,874
Mixer. See Paint mixer.
Moulding machine presser foot or bar, F. L. Creighton ... 485,153
Mosquito canopy, A. T. Vernon ... 485,117
Multiple switchboard systems, test circuit for, C. E. Scribner ... 484,867
Net making machine, W. J. Hooper ... 484,893
Nickel, treating minerals containing, J. De Coppet ... 484,875
Nursery bag, M. J. Forshew ... 485,098
Nut lock, E. Johanson ... 484,994
Nut lock, I. Wolfe ... 485,120
Ore separator and amalgamator, F. J. Hoyt ... 484,933
Ore treating apparatus, H. B. Meech ... 484,861
Organ, cabinet, M. Clark ... 484,929
Padlock, E. A. Judd ... 484,895
Paint mixer, P. Faust ... 484,851
Paint pigment from ores, producing, Smith & Ludwig ... 485,063
Pan. See Grinding pan.
Paper bag machines, etc., mechanism for delivering bags from, A. C. Getten ... 485,006
Paper can, A. T. Cwerdinski ... 485,158
Paper, machine for the manufacture of lace, B. Karfiol ... 484,966
Paper pulp digester, Curtis & Jones ... 484,999, 485,000
Paper weight and calendar, combined, A. D. Palmer ... 485,133
Penholder, perforated, F. M. Libby ... 484,967
Picker. See Berry picker.
Pin. See Tent pin.
Pin fastening, T. Fahrner ... 485,005
Pipe elbow, O. H. Lawrence ... 485,124
Pipe hanger, M. J. Hanna ... 485,033
Pipes and pipe fittings, joint or coupling for, C. R. Schmidt ... 485,116
Planter, corn, O. Boll ... 484,991
Plastic materials, machine for shaping and moulding, O. R. Chase ... 484,777
Plow attachment, C. B. Thornton ... 484,943
Portable safety heater, J. House ... 485,008
Post driver, J. McLandsborough ... 485,051
Potassium carbonate, making, P. Romer ... 484,921
Potato digger, A. A. Pratt ... 484,817
Potato digger, S. N. Washburn ... 485,118
Press. See Baling press. Brick press.
Printer's quoin, A. Cameron ... 484,907
Printers' rules and leads, machine for cutting, F. Wesel ... 484,984
Projectile, J. J. McIntyre ... 484,862
Pulley, split, C. C. Lockstaedt ... 484,935
Pulp producing apparatus, J. B. Carter ... 485,090
Pump, J. P. Lahm ... 484,898
Punch, J. M. Fairfield ... 484,891
Puzzle, C. H. Rickert ... 484,882
Rack. See Hat rack.
Radiator, W. Scott ... 485,018
Rail fastening, T. W. Fay ... 485,097
Railway cross tie, W. M. Hewitt ... 484,855
Railway fish plate, set screw, and nut lock therefor, J. P. McGuire ... 484,809
Railway grip mechanism, cable, J. H. Robertson ... 484,920
Railway point and signal apparatus, interlocking, F. A. Atkinson ... 484,840
Railway system, electric, J. H. Pendleton ... 484,919
Railway track sanding apparatus, A. A. Whipple ... 484,926
Railways, apparatus for carrying ships, etc., upon, W. R. Knipple ... 485,044
Railways, closed conduit for electric, B. F. Sutton ... 484,924
Refrigerating apparatus, D. L. Holden ... 484,913
Refrigerating compound, W. C. Trussell ... 484,983
Register. See Cash register.
Ring. See Finger ring.
Rolling mill, H. Aiken ... 484,767
Rolling mill guide device, H. Aiken ... 484,768
Rolling mill plant, E. L. Clark (r) ... 11,280
Roofing compound, S. Herbert ... 484,794
Rotary engine, F. M. Bailey ... 484,769
Rubber dam clamp, N. Kuns ... 484,800
Saddle, harness, P. Ballentyne ... 484,771
Saddle, harness, S. S. Kurtz ... 484,801
Sash holder, J. B. Okey ... 485,131
Saw gin, B. F. Browne ... 484,906
Scraper, wheeled, P. M. Broadfoot ... 485,085
Screen. See Window screen.
Secondary battery, W. Main ... 485,013
Separator. See Ore separator.
Sewage purifying apparatus, E. E. Scruby ... 484,823
Sewing machine, boot or shoe, Gooding & Keith ... 484,958
Sewing machine quilting attachment, J. C. Galloway ... 485,100
Sewing machine take-up, Snitzer & Kuehn ... 485,019
Sewing machine thread unwinding device, M. B. Reigh ... 485,136
Shades to rollers, attaching window, E. F. Hartshorn ... 484,962
Shearing and punching machine, combined, G. Van Wagenen ... 484,832
Shipping can, reinforced, F. Westerbeck ... 485,119
Ships, construction of, A. P. Bliven ... 484,888
Show stand, F. M. Morrow ... 485,109
Shutter worker, Nickerson & Fleet ... 484,972
Sifter, flour, L. Scruggs ... 484,980
Slate shaving machine, H. & E. Kurtz ... 484,802
Smelting or reducing plant, J. Rourke ... 484,942
Snap hook, F. J. Herrick ... 485,037
Soap, J. Niese ... 485,113
Sodawater apparatus, W. H. Collins ... 484,889
Soldering, electric, E. E. Ries ... 485,017
Speaking tube, L. Strouse ... 484,982
Spring. See Door spring.
Stable, feed, D. Haifley ... 484,791
Stand. See Show stand. Wash stand.
Steam generator or evaporator, G. W. Baird ... 484,946
Steam heater, T. Fearon ... 484,787
Stockings, knitted, L. N. D. Williams ... 485,073
Stone or body, spectrum-colored, J. Jacobson ... 484,934
Stopper. See Bottle stopper. Leak stopper.
Stove, cooking, J. Marce ... 485,049
Strap. See Box strap.
Surgical instruments, etc., sterilizer for, E. Boeckmann ... 484,927
Suspenders, E. Davis ... 485,123
Swinging gate, C. M. Clary ... 484,847
Switch. See Electrical switch.
Syringe, vaginal, T. H. Maddux ... 485,107
Table, J. R. Jordan ... 484,965
Tag making machine, A. C. North ... 484,973
Tea kettle, J. Naber, Jr ... 485,016
Telephone support, G. V. Benjamin ... 485,027
Telephonic transmitter, A. T. Collier ... 484,778
Tent pin, A. S. Comstock ... 484,998
Thermal circuit changer and protective appliance, H. A. Rhodes ... 484,822
Thill support, T. B. Woodward ... 485,023
Thrashing machine straw carrier, J. H. Fulton ... 485,099
Ticket holder, A. P. Dewey ... 485,002
Tie for bags, boxes, etc., D. G. Stone ... 485,067
Tie plate, W. Goldie ... 485,030
Tin from tin plate waste, separating, H. C. W. Harmsen ... 485,035
Tire, cycle, Fane & Lavender ... 484,786
Tire, vehicle wheel, L. K. McClymonds ... 485,110
Tobacco, hand of leaf, G. Falk ... 484,930
Tongue support, W. B. Johnson ... 484,856
Tool, J. Boatner ... 485,148
Top, gyroscopic, J. J. Hardy ... 484,960
Torpedo net, W. W. Winship ... 485,074
Torpedo placer, Peifer, Jr., & Johnston ... 484,864
Toy, S. F. Estell ... 484,850
Toy cannon, C. W. Lucius ... 484,805
Traction engine, D. S. Stewart ... 484,828 to 484,830
Trap. See Animal trap. Insect trap.
Trolley pole catcher, M. M. Wood ... 484,986
Trough. See Feed trough.
Trousers, pattern for draughting, A. F. Mead ... 485,014
Tube. See Speaking tube.
Type finishing machine, T. M. Kenney ... 484,915
Umbrella, F. A. Burnam ... 484,773
Valve and joint, C. S. Bavier ... 484,843
Valve, engine slide, J. D. Stark ... 484,903
Valve, globe, W. J. Quinn ... 485,055
Valve levers, stop for throttle, G. E. Messer ... 484,938
Valve, steam-actuated, T. G. Laney ... 485,046
Vaporizer, G. D. Lynch ... 485,127
Vehicle, C. Comstock ... 485,091
Vehicle starter, J. W. Lee ... 485,125
Vending machine, coin-controlled, G. L. Slater ... 485,140
Vent for liquid receptacles, F. W. Polle ... 484,816
Ventilation, system of house, F. P. Smith ... 485,141
Ventilator, G. H. Ennis ... 484,879
Ventilator, C. Redpath ... 485,059
Violin bow frog, J. A. Houlihan ... 485,038
Wagon brake lever, G. P. Riester ... 485,060
Waist, Z. Demarest ... 485,001
Warmer, body, G. D. Baily ... 485,080
Wash stand, G. H. Gere ... 484,956
Wash stand, A. Janzon ... 485,040
Washing machine, J. H. Bates ... 484,871
Washing machine, D. Gardner ... 484,892
Washing machine, J. C. Thomas ... 485,143
Watch balances and hair springs, mechanism for timing and adjusting, G. E. Hunter ... 484,797
Watch balances and hair springs, system for adjusting to temperature, G. E. Hunter ... 484,796
Water closet flush valve, E. Herdegen ... 485,155
Water closet tank siphon, Wilkins & Blesch ... 484,834
Wells, sand trap for artesian, B. F. Smith ... 485,064
Wheel. See Cycle wheel.
Wheel rim trimming machine, R. Hoopes ... 485,156
Wheel scraper, T. L. Aveling ... 484,841
Whiffletree coupling, B. D. Druen ... 485,003
Wick raising device, H. L. Smith ... 484,981
Windmill, E. J. Barber ... 485,082
Windmill, S. M. Hopkins ... 484,795
Windmill, B. T. Stauber ... 484,826
Window screen, J. Rich ... 484,978
Wire, barbed, J. D. Curtis ... 484,890
Wire coupling, W. E. Banta ... 484,842
Wire netting machines, detector stop motion for, E. S. Bond ... 484,992
Wire stretcher, L. W. Stokely ... 485,066
Wire stretcher and splicer, J. F. Price ... 484,881
Woven fabric, elastic, M. Picot ... 484,977
Wrench, S. Cook ... 485,152
Wringer gear guard, Momburg & Dallmann ... 484,970

DESIGNS.

Banner, J. M. Joy ... 21,927
Bowl, sugar, H. Berry ... 21,921, 21,922
Box cover, S. D. Lux ... 21,923
Carriage body, C. H. Palmer, Jr ... 21,935
Curtain pole bracket, C. W. Smith ... 21,930 to 21,932
Curtain roller bracket, M. J. Matthews ... 21,929
Finger ring, J. H. Fink ... 21,926
Glove, J. Kayser ... 21,918
Handle for spoons, etc., A. H. Ullrich ... 21,919
Match box, S. Zinn ... 21,924
Perfumery holder, J. Markell ... 21,925
Potato digger fork, H. O. Putnam ... 21,934
Spoon, E. M. Black ... 21,920
Tablecloth, F. S. Pinkus ... 21,928
Valve for basins and bath tubs, W. H. Graham ... 21,933
Wall paper, C. Booze ... 21,908 to 21,917

TRADE MARKS.

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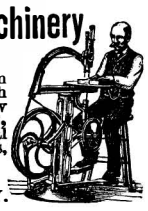
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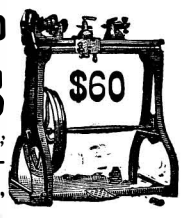

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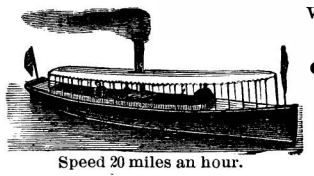
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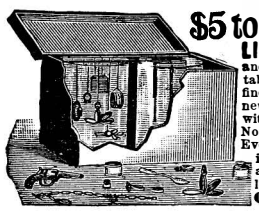
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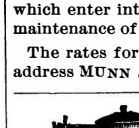
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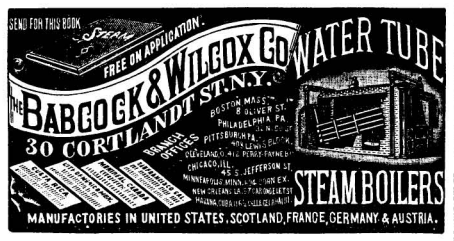
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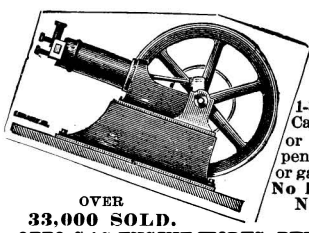
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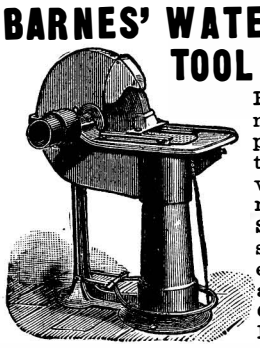
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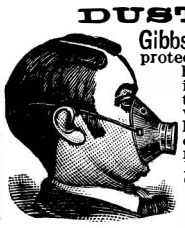
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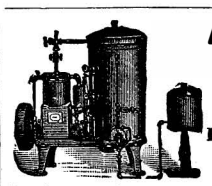
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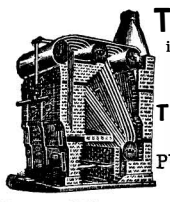
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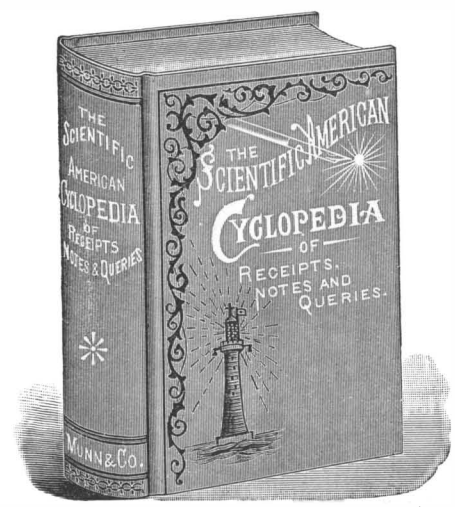

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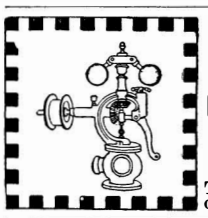

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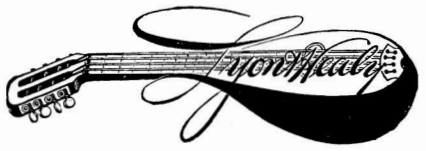

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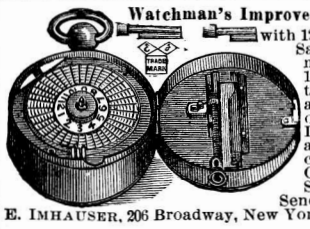

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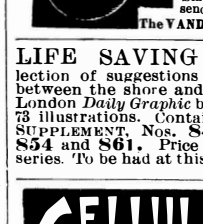

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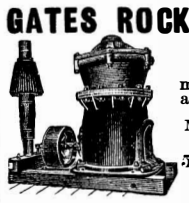

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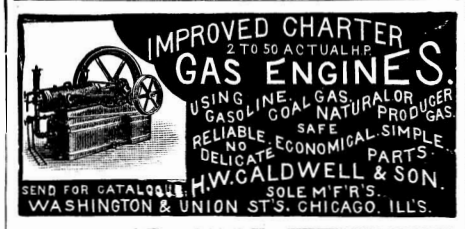

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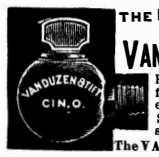

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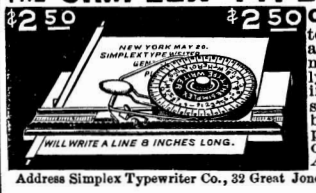

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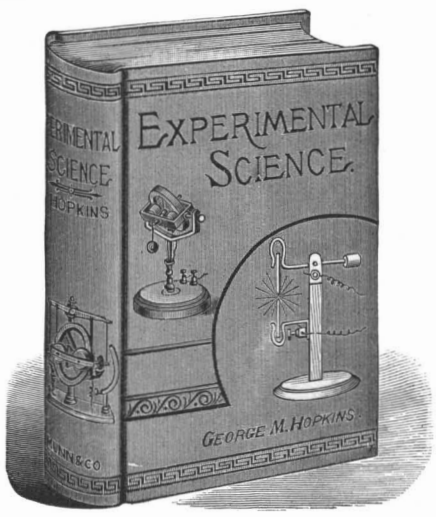

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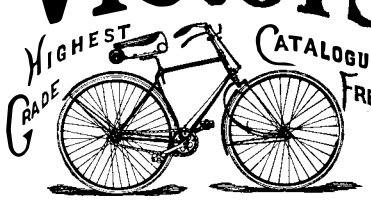

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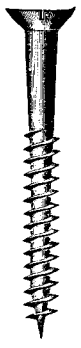

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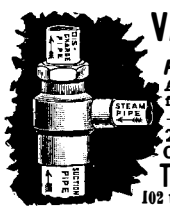

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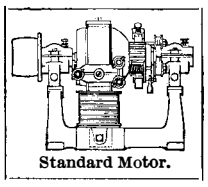
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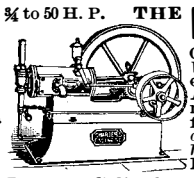

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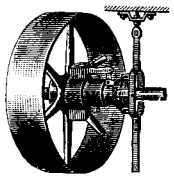

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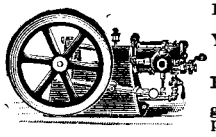

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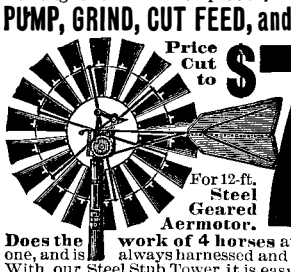

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